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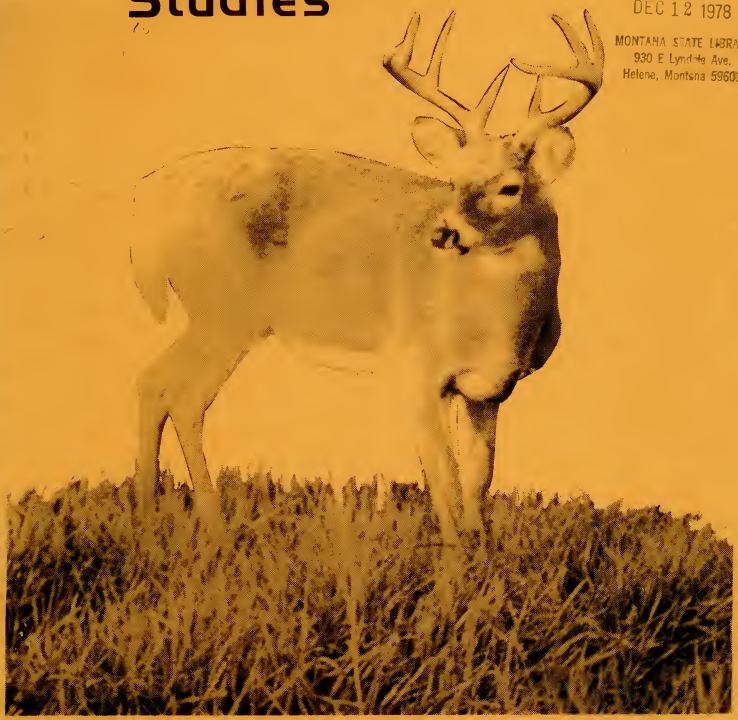

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JOB PROGRESS REPORT

RESEARCH PROJECT SEGMENT

State of Montana

Project W-120-R-9 Name Statewide Wildlife Research

Study No. BG-1.00 Title Statewide Deer Research

Job Nos. 1, 2, 3, 4

Period Covered: July 1, 1977 - June 30, 1978

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INTRODUCTION

In 1975 a statewide deer research program was initiated in Montana. Broadly, the objectives of this program were to:

1. Provide a more detailed understanding of the population biology and habitat relationships of deer and of the factors limiting deer numbers in the diverse environments in which deer occur in Montana;

2. Develop new or improved methods for measuring deer population and habitat parameters, new guidelines for applying existing information and technology more effectively, and/or new criteria for interpreting field data in terms of management needs; and

3. Establish new guidelines for consideration of the habitat requirements and relationships of deer in other game, range, forest, and land management programs and practices in Montana.

The study entails concurrent, comparative investigations on the population ecology and habitat relationships of both mule deer and white-tailed deer in all of the major ecological or broad habitat types on which the two species occur. It includes both descriptive and evaluative research. The former is required to provide essential baseline information concerning deer behavior, habitat requirements and relationships, to clarify existing knowledge, and to develop hypotheses concerning the environmental requirements and relations of deer. The study also involves efforts to promote, assist in, and generally coordinate more extensive and pilot deer management studies across the State, and to draw together and relate findings of these studies to those of more intensive investigations and to the overall study objectives.

Current deer studies are located on the accompanying map of Montana (Fig. A). Solid circles denote deer research study areas from which findings are included in this report. Open circles denote management and other special study locations. Those inscribed with a T are management studies involving only deer population trend and classification measurements to date, though more intensive effort may be planned. Completely open circles denote studies which may also involve tagging and marking, or monitoring radio-collared deer, food and range use habits, and/or other habitat relations. Circles inscribed with an X denote special studies conducted by the Ecological Services Division of the Fish and Game Department and other agencies. The latter include the Decker Deer Study conducted by the U. S. Fish and Wildlife Service and deer studies in Glacier National Park.

Findings from management surveys and investigations are reported independently in Montana Department of Fish and Game Regional Progress Reports under project W-130-R and as other special progress reports from the Ecological Services Division or the Agency concerned.

This report compiles individual study and job progress reports for investigations conducted on or directly in conjunction with the intensive study areas during 1977-78. Individual study reports outline specific job objectives and procedures and present and discuss current findings in relation to information obtained previously as well as through supplementary thesis research projects associated with them. The report by Hamlin, for example, on mule deer studies in the Missouri River Breaks, compiles and analyzes all existing information collected during the past 20 years with respect to factors influencing population trends in that area. Also, the report on mule deer studies in the Bridger Range of southwestern Montana (Mackie, Pac and Jorgensen) includes previously unreported data and a discussion of general distributional and population characteristics of mule deer over the entire Bridger Mountain complex as well as on updating of detailed population studies on the Armstrong winter range.

Two separate publications (Mackie, R. J. 1978. Natural regulation of mule deer populations. 1978 Symposium of the Northwest Section of The Wildlife Society, Vancouver, B. C., Canada; and Mackie, R. J. 1978. Impacts of livestock grazing on wild ungulates. Transactions of the 43rd N. Amer. Wildl. and Nat. Resources Conference, Phoenix, AR) included findings or other information resulting from the Statewide Deer Study.

While all of the studies described are still in progress, and thus most findings are only preliminary or tentative, results to date seem to have provided much new information on the general biology and ecology of deer. Included are a much better and more detailed understanding of distributional characteristics and patterns and their significance in the ecology of natural populations. Also included is a better knowledge of reproductive characteristics and relationships in natural populations as well as the roles of fawn production and survival, population sex and age structure, and mortality patterns of both fawns and adults of both sexes as they influence population size and dynamics annually and in various habitats.

These and other findings provide basis for developing hypotheses concerning effects of various environmental factors on deer populations and at the same time have significant potential for use by management. These include the role of weather, forage supplies, cover, predation, hunting, livestock grazing management and logging or timber management. Some of these have been discussed in past or the present reports; others will be outlined in separate papers and/or in future reports as current concepts are evaluated in light of continued investigation and findings.

The studies reported in this document required the efforts of numerous individuals, both with the Montana Department of Fish and Game and in other agencies. The cooperation of personnel of the U. S. Forest Service, Bureau of Land Management and the U. S. Fish and Wildlife Service, C. M. Russell Wildlife Range, has been especially appreciated. Without their combined interest and effort this study would not be possible. Gratitude is also expressed to numerous private individuals who have, as landowners, provided access to their lands and study areas or otherwise provided assistance in the investigations.

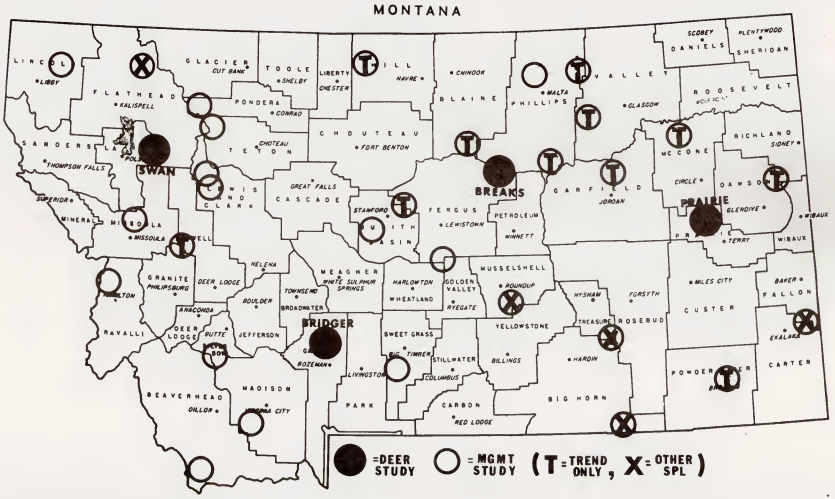

Figure A. Current deer studies in Montana.

JOB TITLE: Population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of northwestern Montana.

ABSTRACT:

Studies, initiated in November 1975, to evaluate factors affecting populations of white-tailed deer (*Odocoileus virginiana*) in the Swan River Valley, Montana, were continued during 1977-78. Sex, age, weight, and body measurements of harvested deer were collected at two checking stations during the 1977 hunting season. Eleven marked deer were harvested and reported, from a minimum sample of 85 marked deer known to be alive during the hunting season. Distribution of hunting pressure and harvest is discussed. Population parameters were determined from a harvest sample of 206 deer, a road-kill sample of 70 deer, a trapping sample of 132 deer, and observations of 4,198 deer. Fawns comprised 26 percent of the harvest during the either-sex portion of the season and 18 percent of the total harvest. Fawns comprised 46, 39, and 32 percent of the road-kill, trapping, and winter classification samples, respectively. Yearlings represented 37, 10, and 20 percent, respectively, of the harvest, road-kill, and trapping samples. Reproductive tracts were collected from 29 adult female deer. No pregnant fawns were examined. Fetal and ovulation rates of 2½-year-old-and-older does were 1.8 and 1.9 per doe, respectively. Patterns of reproductive suppression, determined from a sample of marked does, are discussed. Survival of marked deer also is discussed. Winter observations of deer typically occurred in mixed stands of timber, dominated by Douglas fir (*Pseudotsuga menziesii*), western larch (*Larix occidentalis*), and lodgepole pine (*Pinus contorta*). Several habitat types were represented. Use of natural openings and clearcuts was minor. Browse was the dominant forage class in the winter diet. Use of coniferous species was greater than in prior winters. Winter home range areas of marked deer averaged 51 acres. Home ranges of radio-equipped deer were smaller in 1978, as compared with prior winters. Patterns of summer dispersal, determined from radio-equipped deer, are discussed. Summering areas of individual deer were typified by an interspersion of mature coniferous timber with natural openings and wet sites.

JOB TITLE: Population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of northwestern Montana.

JOB OBJECTIVE: To determine the environmental requirements of white-tailed deer and factors regulating white-tailed deer populations in the coniferous forest habitat of northwestern Montana.

To determine the effects of various potentially competing land use and management practices upon white-tailed deer in northwestern Montana.

To develop new and improved guidelines for management of northwestern Montana white-tail populations and their habitats.

INTRODUCTION:

A study to evaluate the factors affecting populations of white-tailed deer *(Odocoileus virginiana)* in the coniferous forest habitat of northwestern Montana was initiated in November 1975. This study is one phase of a statewide deer research effort to provide more detailed information on the biology and ecological relationships of deer and to provide new and improved guidelines and methods for deer management.

This study continued to emphasize data basic to the distribution, movements, habitat use, and population dynamics of two white-tailed deer populations during FY-78. This report summarizes information about the deer population which winters in the upper Swan River Valley. Information concerning the herd which winters at Salmon Lake was presented elsewhere (Janke 1977).

STUDY AREA

The upper Swan River Valley extends from Swan Lake south to the Swan-Clearwater Divide. The valley lies between the Swan Mountains to the east and the Mission Mountains to the west. The valley is bisected by the Swan River and by Highway 209 which parallels the river. Most of the winter range in the upper valley lies between Goat Creek and Condon. Condon is approximately 65 miles southeast of Kalispell. A description of this area was presented by Hildebrand (1971). The history of game populations in the Swan Valley and summaries of the early studies are included in Weckwerth (1958), Hildebrand (1971), and Mundinger (1976).

METHODS

Hunting Season

Two part-time checking stations were operated during the 1977 hunting season. Hunters were interviewed to determine hunter origin, drainages hunted, time hunted, and animals observed. Locations of animals harvested were plotted on a map, as accurately as possible. Ages of white-tailed deer, mule deer (*Odocoileus hemionus*), and elk (*Cervus canadensis*) were determined by criteria of eruption and wear of teeth of the lower jaw (Severinghaus 1949; Robinette et al. 1957; Quimby and Gaab 1957). First incisors were collected from deer, for analysis of annuli in the cementum layer (Gilbert 1966). Weights and measurements of deer also were collected.

Production

Information concerning fawn production was determined from the classification of 4,002 white-tailed deer during the period of December, 1977 through April, 1978. This was supplemented with classification of animals in the harvest, road-kill, and trapping samples. The reproductive status of 61 marked adult does were determined from ground observations. The reproductive histories of 16 individual does were determined in more than one winter. Reproductive tracts were collected from 29 adult does.

Distribution and Movements

All observations of deer were plotted according to the legal description of the location. A general description of the surrounding habitat also was made. Animals were classified according to age. Attempts were made to classify adult deer according to sex. Because large numbers of deer were not observed until the bucks had dropped their antlers, these data were not reliable. Additional information resulted from the relocation of animals marked for individual recognition.

Migratory patterns and summer range use data were determined by radio telemetry. Radio-equipped deer frequently were relocated from a fixed-wing aircraft. This information was supplemented with ground relocations of these animals and reconnaissance of areas used.

Food Habits

Food habits were determined by rumen analysis. Fifty-three one-quart rumen samples were collected from road-killed deer and trap casualties. Rumen contents were examined according to the techniques described by Wilkins (1957). Analysis of these data followed the aggregate percentage method described by Martin et al. (1946).

RESULTS AND DISCUSSION

Hunting Season

The 1977 hunting season in the Swan Valley extended from 23 October through 27 November. Either-sex deer and elk hunting was permitted until 30 October. Thereafter, only bucks and bulls were legal game. Hunting conditions during the 1977 season generally were good, as periodic light snow falls occurred throughout the season. Two checking stations were operated daily during the either-sex portion of the season and on the week-ends thereafter. The lower Swan station corresponded with checking station data previously reported (Mundinger 1977). The Swan Divide station was not operated during earlier years of this study.

During the season 4,140 hunters were interviewed. Totals of 206 white-tailed deer, 27 mule deer, and 55 elk were examined. This included 3,239 hunters, 154 white-tailed deer, 24 mule deer, and 39 elk at the lower Swan station, and 901 hunters, 52 white-tailed deer, 3 mule deer, and 16 elk at the Swan Divide station.

According to the 1977 hunter questionnaire, the Swan Valley, Hunting Districts 130 and 131, provided 22,031 man-days of deer hunting and 17,660 man-days of elk hunting. The indicated harvest was 736 white-tailed deer, 86 mule deer, 59 deer of unknown species, and 222 elk. The deer hunter success was 20 percent. Questionnaire data for 1977 are compared with 1975 and 1976 in Table 1.

Table 1. Summary of the annual hunter questionnaire for the Swan Valley, Hunting Districts 130 and 131, 1975-77.

	1975	1976	1977
Deer Hunters	4,501	3,673	4,323
Hunter Days	40,511	33,606	39,691
W-T Deer Harvested	635	523	736
Mule Deer Harvested	70	94	86
Elk Harvested	293	125	222
Percent Deer Hunter Success	17	17	20

Several hunting season parameters were determined both from checking station and hunter questionnaire data for the three seasons (Table 2). Checking station data for hunting pressure and harvest during 1976 and 1977 included only those collected on week-ends at the lower Swan station, because that corresponded with the 1975 checking station schedule.

The greatest agreement between data from checking stations and hunter harvest questionnaires occurred in the estimates of the trends in hunting pressure and harvest of white-tailed deer. Both sets of data indicated a decrease in hunting pressure from 1975 to 1976, and an increase from 1976 to 1977 to a level less than that recorded in 1975. However, the rates of change differed, and the differences were not consistent. Both the questionnaire and checking station data indicated a decrease in the harvest of white-tailed deer from 1975 to 1976, and an increase in 1977 to a level greater than that recorded in 1975. As with hunting pressure, the rates of change differed and the discrepancies were not consistent.

Thereafter, there were few agreements between the two sets of data. Trends in mule deer and elk harvests did not agree. This probably reflected small sample sizes, particularly in the checking station results. Proportions of antlered deer in the harvest also disagreed. The proportional distribution, between Hunting Districts 130 and 131, of the white-tailed deer and elk harvests and hunting pressure also were compared. Throughout these data, the results were in disagreement.

Local hunters, people originating from Flathead, Lake, and Missoula Counties, comprised 94 percent of the parties checked at the lower Swan station. A similar percentage was checked during 1976. Local hunters comprised 71 percent of the parties checked at the Swan Divide station. Hunting regulations in the Swan were less restrictive than those in effect in adjacent administrative regions. This had little apparent effect on the hunting pressure in the Swan Valley.

Eleven marked deer were harvested and reported during the 1977 season. Of these, five were recorded at the checking stations and the remainder were reported elsewhere. A minimum of 85 marked deer left the winter range in spring 1977. Population estimates were derived from this marked sample, the number of animals checked, and the questionnaire harvest data (Overton and Davis 1969). These ranged from 3,500 to 5,700, as compared with a range of 4,000 to 7,900 deer during the 1976 season. The maximum harvest rate was 21 percent, assuming a population of 3,500 and a total harvest of 736 white-tailed deer. Several factors precluded the accuracy of these values, and the indicated population decline probably did not occur.

The distribution of hunting pressure and harvest, as recorded at the lower Swan station during the 1976 and 1977 seasons, is presented in Table 3. The distribution of hunting pressure was similar during both years and more than half of the hunting pressure occurred in the drainages between North Lost Creek and Dog Creek in the east side of the valley. This similarity suggested that the distribution of hunting pressure was a reflection of the traditions of individual hunters.

Table 2 . Comparisons of checking station and hunter questionnaire data.

	1975	1976	1977
Hunter Days			
Questionnaire	40,511	33,606	39,691
Check Station	2,750	2,372	2,681
W-T Deer Harvest			
Questionnaire	635	523	736
Check Station	98	74	123
Mule Deer Harvest			
Questionnaire	70	94	86
Check Station	13	12	13
Elk Harvest			
Questionnaire	293	125	222
Check Station	51	19	18
Percent Adult Males			
Questionnaire	55	74	79
Check Station	51	70	61
Percent W-T Harvest			
Questionnaire H.D. 130	72	81	82
H.D. 131	28	19	18
Check Station H.D. 130	82	73	65
H.D. 131	18	27	35
Percent Elk Harvest			
Questionnaire H.D. 130	64	46	74
H.D. 131	36	54	26
Check Station H.D. 130	71	59	78
H.D. 131	29	41	22
Percent Hunting Pressure			
Questionnaire H.D. 130	68	72	74
H.D. 131	32	28	26
Check Station H.D. 130		82	75
H.D. 131		18	25

Table 3 . Distribution of hunting pressure and harvest, by drainage, as determined from the lower Swan checking station interviews, during the 1976 and 1977 hunting season.

Drainage	Hunting Parties 1976	Hunting Parties 1977	W-T Deer 1976	W-T Deer 1977	Mule Deer 1976	Mule Deer 1977	Elk 1976	Elk 1977
Bear Creek-Johnson Creek	107(7)[1]	50(3)	5(5)	4(3)				
6 Mile Creek-Bond Creek	61(4)	65(4)	3(3)	8(5)		1(4)	1(3)	1(3)
West Swan Lake	124(8)	167(11)	5(5)	13(9)	2(13)	7(29)	1(3)	3(8)
North & South Lost Creeks	153(10)	190(12)	7(7)	5(3)	4(27)		3(9)	5(13)
Cilly Creek-Soup Creek	236(16)	238(16)	5(5)	10(7)		1(4)	2(6)	5(13)
Squaw Creek-Van Lake	283(19)	233(15)	13(13)	20(13)	1(7)		10(31)	4(10)
Lion Creek-Dog Creek	117(8)	165(10)	8(8)	20(13)	4(27)	4(17)		13(33)
Condon Creek-Smith Creek	95(6)	68(4)	18(18)	10(7)	2(13)			
Cooney Creek-Owl Creek	54(4)	75(5)	10(10)	11(7)	1(7)		2(6)	
Subtotal H.D. 130	1,230(82)	1,271(81)	74(73)	101(67)	14(93)	17(71)	19(59)	31(86)
Woodward Creek-Fatty Creek	61(4)	71(5)	1(1)	8(5)	1(7)	4(17)	6(19)	1(3)
Piper Creek-Cold Creek	129(9)	137(9)	10(10)	17(11)		2(18)	3(9)	1(3)
Elk Creek-Kraft Creek	59(4)	79(5)	12(12)	21(14)		1(14)	3(9)	3(8)
Lindbergh Lake-Beaver Creek	17(1)	14(1)	4(4)	4(3)			1(3)	
Subtotal H.D. 131	266(18)	301(19)	27(27)	50(33)	1(7)	7(29)	13(41)	5(14)
Total	1,496	1,572	101	151	15	24	32	36

[1]Percentages of the total in parentheses.

There were no apparent relationships between the distributions of hunting pressure and the harvest of white-tailed deer. During both 1976 and 1977, disproportionate percentages of deer, relative to hunting pressure, were harvested south of Condon Creek on the east side of the valley and south of Elk Creek on the west side. The greatest summer concentrations of deer apparently occur in these drainages, yet there was no response to this availability. Hunting pressure during 1976 appeared to be related to the distribution of the elk harvest, but this relationship was not evident for 1977.

Distributions recorded at the Swan Divide station are presented in Table 4. The most noteworthy trend was the decline in hunting pressure with increasing distances north from the Swan-Clearwater Divide. Eighty-four percent of the hunting pressure occurred south of Condon.

A comparison of the white-tailed deer harvest distribution during 1977 and previous years is presented in Table 5. Noteworthy changes since 1959 included a reduction in the proportion of the harvest taken between Squaw Creek and Dog Creek, an average of 47 percent during 1948-59 as compared with 21 percent in 1977; an increase in the proportion of the harvest taken from south of Condon, an average of 22 percent during 1948-59 as compared with 44 percent in 1977; and, a broader distribution of the harvest. These differences reflect an increase in the road density throughout the valley and a probable decline in the density of deer which summers in the Squaw Creek-Dog Creek area.

Age Data

The age distribution of the 1975, 1976, and 1977 harvests of white-tailed deer are presented in Table 6. Animals were assigned to the fawn, yearling, and 2½-year-old classes according to criteria of eruption-wear (Severinghaus 1949). Older deer were assigned to age-classes according to an analysis of the dental cementum of the first incisor (Gilbert 1966). In addition to the animals for which age data were obtained, 30, 7, and 7 unclassified adults were checked during the 1975, 1976, and 1977 seasons, respectively. Conclusions regarding the 1975 adult population are tentative because of the large number of unclassified animals that year.

Classification data had suggested that fawn production was greater in 1976 than in 1975 (Mundinger 1977). This trend was not evident in the harvest data. A smaller percentage of fawns harvested during 1976 probably was related to the large number of unclassified adults in the 1975 sample, the large percentage of yearlings in the 1976 sample, and the more restrictive regulations during 1976. The harvest data indicated an increased rate of fawn production in 1977. This was consistent with trends in the classification data.

The proportion of fawns in the male samples was influenced by the split seasons. Fawns comprised 29, 29, and 24 percent, respectively, of the males harvested during the 1975, 1976, and 1977 either-sex seasons.

Table 4 . Distribution of hunting pressure and harvest, by drainage, as determined from the Swan Divide checking station interviews during the 1977 hunting season.

Drainage	Hunting Parties	W-T Deer	Mule Deer	Elk
Bear Creek-Johnson Creek				
6-Mile Creek-Bond Creek				
West Swan Lake	3 (1)[1]	1 (2)		
North & South Lost Creek	4 (1)	2 (4)		1 (7)
Cilly Creek-Soup Creek	5 (1)			
Squaw Creek-Van Lake	7 (2)		1 (33)	
Lion Creek-Dog Creek	21 (5)	3 (6)		
Condon Creek-Smith Creek	36 (9)	4 (8)	1 (33)	
Cooney Creek-Owl Creek	135 (34)	21 (40)	1 (33)	8 (53)
Subtotal H.D. 130	211 (53)	31 (60)	3 (100)	9 (60)
Woodward Creek-Fatty Creek	3 (1)			
Piper Creek-Cold Creek	22 (6)	2 (4)		1 (7)
Elk Creek-Kraft Creek	70 (18)	12 (23)		
Lindbergh Lake-Beaver Cr.	90 (23)	7 (13)		5 (33)
Subtotal H.D. 131	185 (47)	21 (40)		6 (40)
Total	396	52	3	15

[1]Percentages of the total in parentheses.

Table 5. Comparison of the percentage of the white-tailed deer harvest, by drainage, from checking station data, 1948-1977.

	1948[1]	1949[1]	1957[1]	1958[1]	1959[1]	1962[2]	1975[2]	1976[2]	1977[2]	1977[1]
Sample size	48	51	255	196	196	39	91	101	151	203
Drainage										
East Swan Lake	27	18	4	8	3	8	9	8	8	6
West Swan Lake				2	5	3	2	5	9	7
North and South Lost Creeks		4	6	5	1	8	7	7	3	3
Cilly Creek-Soup Creek	4	6	7	4	7	8	8	5	7	5
Squaw Creek-Van Lake	31	31	21	19	32	21	22	13	13	10
Lion Creek-Dog Creek	23	16	22	13	25	15	8	8	13	11
Condon Creek-Smith Creek	4	2	5	11	5	10	22	18	7	7
Cooney Creek-Owl Creek	8	10	18	14	9	13	6	10	7	16
Subtotal H.D. 130	98	86	82	76	87	85	82	73	67	65
Woodward Creek-Fatty Creek	2	12	5	6	9	3	4	1	5	4
Piper Creek-Cold Creek			4	8	1	3	9	10	11	9
Elk Creek-Kraft Creek		2	4	2	1	10	4	12	14	16
Lindbergh Lake-Beaver Creek			4	8	2			4	3	5
Subtotal H.D. 131	2	14	18	24	13	15	18	27	33	35

[1]Data summarized from two checking stations.
[2]Data summarized from lower Swan checking station only.

Table 6. Percent composition, by age-class, of the white-tailed deer harvest in the Swan Valley, 1975-77.

	Females			Males			Total		
Age-Class	1975	1976	1977	1975	1976	1977	1975	1976	1977
1/2	30	14	31	14	12	11	20	12	18
1 1/2	13	57	17	33	39	46	25	43	37
2 1/2	17	14	25	25	22	16	22	21	19
3 1/2	9		5	8	4	11	8	3	9
4 1/2	9	5	9		8	10	3	7	10
5 1/2			2	8	3	1	5	2	1
6 1/2	9	5	3		4	3	3	4	3
7 1/2	9			6	3		7	2	
8 1/2		5	3	6	4		3	4	1
9 1/2					1			1	
10 1/2			3			1			2
11 1/2									
12 1/2									
13 1/2	4						2		
14 1/2			2						1
Sample Size	23	21	64	36	76	135	59	97	199

The harvest data suggested that the 1976 fawn crop contained disproportionately few females. The female:male ratio for the fawn class was 1.4:1 and 1.3:1 during 1975 and 1977, respectively. The ratio was 0.33:1 during 1976. These differences were supported by the harvest sex and age structure. Female fawns were well represented in the 1975 harvest and females of this year-class continued to be well represented in 1976 and 1977. Conversely, female fawns were poorly represented in 1976 and the percentage of yearling females declined in the 1977 harvest.

The percentage of yearling males in the harvest was consistently high. The data probably were biased in favor of this group.

The percentage of 3½-year-old animals of the harvest did not seem to be an accurate representation of the population age structure. Likewise, the percentage of 5½-year-old deer was questionable. It is probable that the harvest is biased against these age-classes. The discrepancies also may reflect errors in assigning ages.

The collection of jaws from adult white-tailed deer permitted a comparison between eruption-wear and dental cementum as methods for determining the age of white-tailed deer. Fifty-eight deer were assigned to the 2½-year-old class. Fifty-five of these were aged as 2½-year-olds by both methods. Ages of the remainder were incorrectly determined from the dental cementum, with one assigned to the yearling class and two assigned to the 3½-year-old class. Twenty-one deer were assigned to the 3½-year-old class. Of these, the ages of 19 were correctly determined by both methods and two were incorrectly assigned to the 2½-year-old class by dental cementum. Several deer had been assigned to this age class by eruption-wear. Analysis of dental cementum indicated that these animals were older. Twenty-two deer were assigned to the 4½-year-old class, according to cementum annulations. Of these, three were correctly determined and 19 were incorrectly assigned to the 3½-year-old class according to wear characteristics. Two deer were assigned to the 5½-year-old class by dental cementum; both had been assigned to the 3½-year-old class by eruption-wear. Eleven deer were assigned to the 6½-year-old class by dental cementum. Of these, one, six, and four were assigned to the 3½-year-old, 4½-year-old, and 5½-year-old classes, respectively, by eruption-wear. Of the four deer which were assigned to the 7½-year-old class by dental cementum, two had been assigned to the 4½-year-old class and two had been assigned to the 5½-year-old class by eruption-wear. Seven deer were assigned to the 8½-year-old class by dental cementum. Eruption-wear had assigned four, two, and one of these to the 4½-, 5½-, and 6½-year-old classes, respectively. One 9½-year-old deer, by dental cementum, had been assigned to the 5½-year-old class by wear characteristics. Of three 10½-year-old deer, by dental cementum, two had been assigned to the 5½-year-old class and one to the 6½-year-old class by eruption-wear. The 13½-year-old deer and 14½-year-old deer, by dental cementum, each had been assigned to the 7½-year-old class by eruption-wear.

This sample contained only two known-age animals. One of these was 2½-years-old; the other was 3½-years-old. The age of each was correctly determined by each method. A third marked deer was included in the sample. The age of this doe was estimated as 5½-years when she was marked in March 1976. She was harvested in October 1977. Her age was determined to be 5½-years by eruption-wear, and 8½-years by dental cementum.

Conclusions from this comparison are tentative because known-age animals are lacking in the sample. Eruption-wear is assumed to be completely reliable through 2½-years. Fawns and yearlings are accurately determined by the characteristic combinations of deciduous and permanent dentition which were described by Severinghaus (1949). Deer at 2½-years have a full compliment of adult teeth and the lack of both wear and staining are very distinctive. The accuracy of ages that were determined by eruption-wear for older deer is

questionable. Ages determined by wear characteristics consistently were younger than ages determined from annulations in the dental cementum. Wear patterns on the teeth of white-tailed deer from the Swan Valley apparently do not develop as rapidly as those described by Severinghaus (1949).

The results which were obtained by dental cementum were considered to be more reliable than those obtained by eruption-wear for the older age-classes. However, this does not presume that all of these ages were accurate. That incorrect ages apparently were determined by dental cementum for a few younger animals implied that errors also occurred in the older age-classes. However, wear characteristics were not an adequate cross-check for older deer.

Few examples of tooth sections, in which each annulation could be determined with certainty, were encountered. Typically, annuli were incomplete in certain regions of the section, while in other portions the annuli were compressed and difficult to distinguish. That count of annuli with the best agreement between sections of the same tooth was, therefore, assumed to be indicative of the age of the animal.

Weights and Measurements

Average hog-dressed weights and body measurements were collected at the check stations. Body measurements included total length, from the tip of the nose to the base of the tail; height, at the shoulder; and, length of the hind foot. Antler measurements also were taken from males. These included the number of antler points on each side, the diameter of the main beam at a point one-inch above the burr, and the length of the main beam. Data for the three hunting seasons were pooled.

Weights and measurements of females are presented in Table 7. This information suggests that females continued to grow in body size through 3½-years and continued growth in weight through 4½-years. Weight variations both within and between age-classes probably were related, in part, to lactation, although this was not tested.

Weights and measurements of males are presented in Table 8. Males continued growth, both in weight and body size, through 5½-years. Significant increases in antler growth occurred through 4½-years. Males evidenced large variation in size and weight within individual age-classes. For example, weights ranged from 100 to 141 pounds for yearlings, 120 to 180 pounds for 2½-year-olds, 140 to 213 pounds for 3½-year-olds, and 145 to 215 pounds for 4½-year-olds. A portion of this variation was due to the time that each animal was harvested, relative to the onset of the rut. Sample sizes, however, were too small to measure this influence.

Variations in males also seemed to be related to individual differences in growth potential. These differences probably are evident at an early age.

Hog-dressed weights of Swan Valley white-tailed deer were heavier than average weights for Montana, as reported by Mackie (1964). They also were heavier than those reported for the Fisher River-Wolf Creek area in northwest Montana (Firebaugh et al. 1975).

Table 7. Average hog-dressed weights and body measurements of female white-tailed deer harvested in the Swan Valley, 1975-77.

Age	Weight (lbs)	Length (Cm)	Height (Cm)	Hind Foot (Cm)
1/2	59	114	78	41
1 1/2	97*	133*	87*	46*
2 1/2	106*	139*	91*	46
3 1/2	110	147*	93	46
4 1/2	122*	144	92	47
6 1/2	114	143	91	47
7+	121	148	93	47

* Significantly greater, $P<0.05$, than preceeding number in the column.

Table 8. Average hog-dressed weights and body measurements of male white-tailed deer harvested in the Swan Valley, 1975-77.

					Antler		
Age	Weight (lbs)	Length (Cm)	Height (Cm)	Hind Foot (Cm)	Points	Diameter (Cm)	Length (Cm)
1/2	65	116	81	42			
1 1/2	114*	141*	94*	48*	2.1	1.8	22
2 1/2	146*	151*	99*	50*	3.7*	2.4*	37*
3 1/2	162*	159*	103*	50	4.4*	2.9*	46*
4 1/2	176*	158	102	50	4.6	3.2*	51*
5 1/2	211*	168*	104	52*			
6 1/2	181	164	104	49			
7 1/2	179	164	100	51			
8 1/2	192	165	102	52			
9+	180	150	105	48			
5+	189**	164**	103	50	5.2	3.5*	54

* Significantly greater, $P<0.05$, than preceeding number in column.

** Significantly greater, $P<0.10$, than corresponding values for 4 1/2-year olds.

Fawn Production

Observations of 4,198 white-tailed deer were made between December 1977 and April 1978. Of these, 4,002 were classified to age-class (Table 9). These data indicated a fawn/adult ratio of 47.8/100, or a population comprised of 32.4 percent fawns. Estimated fawn production was higher than recorded in 1975-76 and 1976-77. The 1978 classification data are compared with that observed in prior years in Table 10.

A sample of 292 deer was observed during the eight replications of the upper Swan Valley trend route. Recruitment estimates derived from this sample generally agreed with those derived from the much larger sample which was observed throughout the winter (Table 9).

An attempt was made to obtain summer classifications. Few deer were observed during daylight hours. Therefore, spotlight surveys were conducted before sunrise and after sunset during August and September. A total of 116 deer was observed. This included 84 adults, of which 66 were females, 13 were males, and 5 were unclassified; 24 fawns; and, 8 unclassified deer. Corresponding ratios were 36 fawns/100 does and 20 bucks/100 does. This sample probably was strongly biased in favor of adult females without fawns. The ratio of 65 fawns/100 does observed during December probably was a reasonable estimate of fawn production.

Fawn/adult and fawn/doe ratios, among animals harvested during the either-sex hunting season, were 36/100 and 70/100, respectively, for 1977. Corresponding values were 45/100 and 87/100 during 1975, and 27/100 and 55/100 during 1976. The ratio of adult females/adult males was 106/100, as compared with 107/100 and 100/100 recorded in 1975 and 1976, respectively.

Data gathered during the 1977 hunting season indicated that the proportion of yearlings in the herd was intermediate to that observed in 1975 and 1976. Eleven of 45 (24 percent) adult females, 62 of 120 (52 percent) adult males, 73 of 165 (44 percent) adults, and 37 percent of the total harvest were yearlings. Respective percentages were 20, 39, 33, and 26 in 1975, and 55, 44, 47, and 41 percent in 1976. Harvest data had indicated a decline in fawn production from 1975 to 1976 (Table 6), which was consistent with changes observed in the yearling segment of the herd. However, this trend conflicted with the trend in fawn production as observed in field classifications (Table 9). Trends in fawn production from 1977 to 1978 were consistent between the harvest and field classifications.

Classifications of road-kill and trapped deer samples are included in Tables 11 and 12, respectively. Fawns comprised a greater percentage of the road-kills but a smaller percentage of the trapped animals, as compared with 1977. The percentage of yearlings in both samples increased, as compared with 1977.

Reproductive tracts were collected from 29 adult females (Table 13). All of the adult does examined were pregnant. Fetal and ovulation rates for yearlings were 1.33 and 1.8 per doe, respectively. Corresponding values were 1.8 and 1.9 per doe for older does. These values were higher than those recorded during the previous two winters (Mundinger 1976, 1977). Higher in utero

Table 9. Monthly classifications of white-tailed deer in the upper Swan River Valley based on field observations during the winter, 1977-1978.

Month	Total	Classified	Adults	Fawns	Uncl.	ff/100 Ad.	% ff	% Uncl.
December	152	139	91	48	13	53	34.5	8.6
low[1]		53	36	17		47		
high[2]		27	16	11		69		
January	648	601	405	196	47	48	32.6	7.3
low		50	40	10		25		
high		34	21	13		62		
February	2,089	2,022	1,366	656	67	48	32.4	3.2
low		70	52	18		35		
high		127	79	48		61		
March	1,240	1,174	798	376	66	47	32.0	5.3
low		48	34	14		41		
high		111	71	40		56		
April	69	66	47	19	3	40	28.8	4.3
1978 Total	4,198	4,002	2,707	1,295	196	48	32.4	4.7
Trend Route	292	282	194	88	10	45	31.2	3.4
1977 Total	3,743	3,439	2,429	1,010	304	42	29.4	8.1
1976 Total	2,269	2,119	1,519	600	150	39	28.3	6.6

[1] Daily classification with the lowest fawn/adult ratio during the month.

[2] Daily classification with the highest fawn/adult ratio during the month.

Table 10 . White-tailed deer fawn/adult ratios in the Swan River Valley, 1958-1978.

Year	Adults	Fawns	Fawns/ 100 adults	Percent Fawns
1958	167	99	59	37
1959	207	68	33	25
1960	77	30	39	28
1961	19	8	42	30
1962	80	33	41	29
1963	59	31	53	34
1964	234	90	38	28
1965	188	108	57	36
1966	33	17	52	34
1967	51	26	51	34
1968	30	26	80	46
1969	122	55	45	31
1970	249	112	45	31
1971	66	28	42	30
1972	42	13	31	24
1976	1,519	600	39	28
1977	2,429	1,010	42	29
1978	2,707	1,295	48	32

Table 11. Sex and age classification of 70 white-tailed deer in the 1978 road kill sample.

Sex	Fawn	Yearling	Adult
Female	17	5	29
Male	15	1	3
Total	32	6	32

32 fawns/38 adults = 84 ff/100 adults or 46% fawns (48/100 or 32%)[1]

32 fawns/34 adult females = 94 ff/100 does (71/100)

6 yearlings of 38 adults = 16% yearlings (10%)

34 adult females/4 adult males = 850 adult females/100 adult males (200/100)

[1]Comparable 1977 data in parentheses.

Table 12. Sex and age classification of 132 white-tailed deer in the 1978 trapping sample.

Sex	Fawn	Yearling	Adult
Female	23	19[1]	47[2]
Male	29[3]	8	6[4]
Total	52	27	53

52 ff/80 adults = 65 ff/100 adults or 39% fawns (70/100 or 41%)[5]

52 ff/66 adult females = 78 ff/100 does (83/100)

19 yearlings of 66 adult females = 29% yearlings (25%)

27 yearlings of 80 adults = 34% yearlings (32%)

[1]Sample includes 2 deer marked in 1977 and 1 trap casualty.
[2]Sample includes 3 deer marked in 1976, 1 deer marked in 1977, and 5 trap casualties.
[3]Sample includes 1 trap casualty.
[4]Sample includes 1 deer marked in 1977.
[5]Comparable 1977 data are presented in parentheses.

Table 13. Summary of 1978 reproductive tract collections.

Date	Age	C. L. of Pregnancy	Embryos	C-R Length (cm)	Weight (gm)
2/6	1 1/2	2	1 ♂		
2/12	1 1/2	2	1 ♀	11.1	36.9
			1 ♀	10.5	37.8
2/13	1 1/2	1	1 ♀	14.7	81.8
3/1	1 1/2	2	1 ♀	19.8	262.0
3/20	1 1/2		1 ♂		
4/11	1 1/2	2	1 ♀	23.8	477.0
			1 ♀	25.0	492.0
1/13	2 1/2	2	1 ♂	7.3	11.8
			1 ♀		
1/17	2 1/2	1	1 ♂	7.2	12.4
3/3	2 1/2	2	1 ♂	18.0	238.0
			1 ♂	18.2	253.0
3/6	2 1/2	2	1 ♀		
3/30	2 1/2		1 ♀		
			1 uncl.		
1/27	3 1/2	2	2 uncl.		
2/10	3 1/2	2	1 ♀	15.5	119.0
			1 ♀	15.7	116.2
3/6	3 1/2[1]	1	1 ♀	20.8	338.0
3/20	3 1/2		2 uncl.		
3/23	3 1/2	2	1 ♂	25.0	445.0
			1 ♂	23.7	423.0
3/23	3 1/2	2	1 ♀	24.5	482.0
			1 ♂	24.2	460.0
1/5	4 1/2		Pregnant		
1/10	4 1/2		Pregnant		
1/19	4 1/2		Pregnant		
2/13	4 1/2	2	1 ♂	12.0	53.9
			1 ♀	12.0	51.5
3/23	4 1/2	2	1 ♂	25.7	465.0
			1 ♂	25.5	454.0

Table 13 (continued).

2/24	5 1/2	2	1♂	19.8	253.0
			1♀	19.6	238.0
1/21	6 1/2	2	Pregnant		
3/3	7 1/2	2	1♀	17.8	178.0
			1♂	18.2	202.0
2/7	8 1/2		Pregnant		
3/13	8 1/2	2	1♀	23.0	424.0
			1♂	24.0	520.0
1/21	10+	2	1♂	9.1	22.4
			1♂	9.0	26.2
3/10	10+	3	1♀	26.0	499.0

[1] One ovary and part of reproductive tract missing from this sample.

productivity during 1978 may have been related to the extremely mild winter incurred during 1977. None of the 14 female fawns examined was pregnant.

Data indicative of the potential productivity of the Swan Valley white-tail herd are summarized in Table 14. These data are a pooled sample from 1970 (Hildebrand 1971), 1976, 1977, and 1978 collections. Yearlings comprised the youngest breeding-class in the herd. Ninety-six percent of the adult does, yearling and older, was pregnant. The fetal rate for all females was 1.5 fetuses/doe. Hildebrand (1971) compared the reproductive potential of this herd with others, as reported in the literature, and concluded that the in utero productivity of the Swan herd was low.

Table 14. Reproductive potential, by age-class, as determined from 1970[1], 1976, 1977, and 1978 collections of reproductive tracts in the Swan Valley.

Age	Sample Size	Percent Pregnant	Fetuses per Doe	Fetuses Per Pregnant Doe	Ovulation Rate[2]
1/2	33	0			
1 1/2	14	100	1.2	1.2	1.5
2 1/2[3]	13	92	1.5	1.6	1.8
3 1/2	21	100	1.8	1.8	1.9
4 1/2	14	93	1.6	1.8	2.0
5+	13	92	1.5	1.7	2.1

[1] 1970 data from Hildebrand (1971)

[2] Ovulation rates from 1976-78 data only

[3] The non-parous female in this sample had aborted (Hildebrand 1971)

Information obtained from collared females permitted further insight to the reproductive status of the Swan Valley herd. The reproductive performance of 19, 45, and 61 marked does was determined from field observations during 1976, 1977, and 1978, respectively (Table 15). None of the yearlings in this sample was observed with fawns. This was consistent with the lack of pregnant fawns in the sample of reproductive tracts (Table 14).

Table 15. Reproductive performance of marked does by age-class.

Age-Class	1 1/2	2 1/2	3 1/2	4 1/2	5+	Total
1976						
Number of does	3	3	2	5	6	19
Number of successful does	0	1	1	3	5	10
Percent success	0	33	50	60	83	53
Number fawns	0	1	1	3	7	12
ff/100 does	0	33	50	60	117	63
1977						
Number of does	13	5	8	2	17	45
Number of successful does	0	1	3	2	10	16
Percent success	0	20	38	100	59	36
Number fawns	0	1	3	2	15	21
ff/100 does	0	20	38	100	88	47
1978						
Number of does	14	18	10	8	11	61
Number of successful does	0	8	8	5	8	29
Percent success	0	44	80	63	73	48
Number fawns	0	8	8	5	10	31
ff/100 does	0	44	80	63	91	51
Total						
Number of does	30	26	20	15	34	125
Number of successful does	0	10	12	10	23	55
Percent success	0	38	60	67	68	44
Number fawns	0	10	12	10	32	64
ff/100 does	0	38	60	67	94	51

Thirty-eight percent of the 2½-year-old does was observed with fawns (Table 15). This contrasted with the pregnancy rate of 100 percent for the yearling age-class (Table 14). Potential fawn production for this class, as determined from the sample of reproductive tracts, was 119 fawns/doe. The observed fawn/doe ratio of 38/100 (Table 15) represented a 68 percent loss of fetuses.

Sixty percent of the 3½-year-old does was observed with fawns, in contrast with the 92 percent pregnancy rate observed for 2½-year-olds. None of the does in this group was observed with twins. The fawn/doe ratio for 2½-year-old does represented a 60 percent loss of the potential production.

Sixty-seven percent of the 4½-year-old does was observed with fawns. None was observed with twins. This contrasted with the pregnancy rate of 100 percent and fetal rate of 1.8/doe observed for 3½-year-old does. The observed fawn/doe ratio represented a 63 percent fawn loss in the 4½-year-old age-class. The increased rate of fawn loss in this class, as compared with 3½-year-old does, resulted from a higher fetal rate and the lack of twins with 4½-year-old does.

Sixty-eight percent of 5½-year-old and older does was observed with fawns. This group included the only females which were observed with twin fawn litters. Twenty-six percent of the old does and 39 percent of the successful old does was observed with twins. These observations contrasted with a pregnancy rate of 93 percent, a fetal rate of 1.55/doe, and a potential of 64 percent twin fawn litters for 4+-year-old does. The rate of loss of potential fawns was 39 percent for old does.

Cumulatively, 58 percent of all adult does, 2½-years-old and older, successfully reared fawns. Productivity was 67 fawns/100 does. This represented a loss of 55 percent of the potential fawn production.

The reproductive performance of individual does during two or more successive years was determined for a sample of 16 adult does, 2½-years-old and older (Table 16). This sample provided 22 cases of 2-year histories. Does successfully reared fawns only in alternate years in 12 (54 percent) of these cases. There were 5 (23 percent) cases each of reproductive failure and reproductive success during two consecutive years. Those does which failed in consecutive years were younger animals, while those which produced fawns in consecutive years were old animals.

Three-year histories were obtained from six does. Of these, two were failures during the three years, one was successful during one year, and three were successful during two years. There was no example in which a doe was successful during three consecutive years.

Further evidence of alternate year production in the Swan Valley population was provided by the reproductive rates which were recorded for individual year-classes during consecutive years (Table 15). The most notable was the 1973 year-class, does which were 2½-years-old in 1976. The sum of the 1976 and 1977 success rates was 71 percent, while the sum of the 1977 and 1978 rates was 101 percent.

The reproduction data demonstrated that the net productivity of the Swan Valley herd is considerably less than its potential and that several factors apparently contribute to this difference. In utero productivity in all age classes is less than the reproductive potential which is reported for the species. Fawns fail to breed. Reproductive failures are typical during the first two breeding cycles. Although does in their second and third breeding cycles frequently conceive twins, these does do not successfully rear twins.

Table 16. Summary of reproductive histories for 16 individual marked does.

Deer No.	Estimated age in 1976	Number of fawns in 1976	Number of fawns in 1977	Number of fawns in 1978
4-76	5 1/2		2	0
27-76	2 1/2	0	0	1
29-76	5 1/2	2	2	
36-76	3 1/2	0	1	
41-76	6 1/2	1	1	
49-76	4 1/2	1	0	
50-76	5 1/2	2	0	
51-76	2 1/2		0	1
55-76	6 1/2	1	1	
60-76	4 1/2	0	0	0
69-76	6 1/2	0	1	1
75-76	4 1/2	1	0	1
85-76	2 1/2	0	0	0
86-76	6 1/2	0	2	1
92-76	4 1/2		0	1
60-77	2 1/2		1	0

In utero productivity declines in the older age-classes. Although old does are more successful than younger does at rearing twins, only 60 percent of the potential twin fawn litters was observed with the marked old doe sample. Also, one-third of the old does in the sample failed to rear fawns. Reproductive success only in alternate years is typical in all age-classes.

The reproductive data also suggested a relationship between winter severity and productivity, although this question needs further study. The 1976-77 winter was unusually mild, typified by warm temperatures and light snowfall. Distributional data indicated that the deer were less confined and that deer were wintering on spring-fall ranges (Mundinger 1977). In utero productivity was greater, both for yearlings and older does, during 1978, as compared with 1976 and 1977. Further, net productivity by 2½- and 3½-year-olds, does in

their first two breeding cycles, was substantially greater following the mild winter (Table 15). Verme (1977) indicated that neo-natal fawn loss was a function of winter severity. Mackie et al. (1976) indicated that fawn production and survival among mule deer in the Bridger Mountains was directly related to the extent to which the deer was able to use all portions of the winter range and all forage resources.

Less than half of the conceived fawns was reared and recruited to the adult population. How this loss occurred is open to speculation. Neo-natal mortality, as a result of nutritive failure (Verme 1962), probably was an important factor which effected the observed reproductive patterns. The strongest evidence for neo-natal mortality was the tendancy for alternate year reproductive success. Verme (1967, 1968) described a situation in which reproductive failure, due to nutritive failure, by does on poor winter nutrition, contributed to reproductive success in the following year.

Verme (1967) suggested that the ratio of fawns to adult does, 2½-years-old and older, in the either-sex harvest was correlated with estimated neo-natal losses. He associated harvest ratios of 1.23 fawns/doe and 0.64 fawn/doe with neo-natal mortality estimates of 10 and 50 percent, respectively. Harvest samples from the Swan Valley were too small to compare with his data. However, a ratio of 0.67 fawn/adult doe was observed with the sample of marked does. This was associated with an estimated 55 percent loss of potential fawns.

O'Pezio (1978) observed fawn loss of 22 and 19 percent for does 2-years-old and 3-or-more-years-old, respectively, during the first two weeks post-parturition. Fawn losses were negligible during the two month period thereafter. Mortality factors were not defined.

It is hypothesized that the observed patterns of reproduction are mechanisms which operate to maintain stable levels of fawn production in the Swan Valley herd. In turn, they reflect a tendancy toward a stable population. The rate of reproductive success tends to be fixed for 3+-year-old does, with fluctuations in the success rate dampened by alternate year production. Variations which occurred in the data probably were artifacts of the small sample sizes.

Although alternate year production is less rigid in the older age-classes, consecutive year success has only a small impact on total fawn production because it involves a small absolute number of females. Conversely, consecutive year failures occur in the younger age-classes and involve a large number of does.

Annual variation in total fawn production is largely a function of variation in the reproductive rate of 2½-year-old does and population age structure. A large population will tend to be dominated by young animals. Further population increases will be suppressed because young does produce fawns at a reduced rate. Conversely, low population levels tend to be dominated by older animals. Further declines will be suppressed because these animals produce at a greater rate.

A year which favors fawn production will have its greatest influence on 2½-year-old does. Production by 3½-year-old does also will be favored, because

most of these animals had failed the previous year. Such was the case during 1977-78, a year which followed an unusually mild winter. During 1978, reproductive success rates doubled for 2½- and 3½-year-old does (Table 15), and the estimated recruitment rate increased (Table 9), as compared with 1977.

The effect of a favorable year will be dampened by reduced productivity the following year. This should obtain because of the increased percentage of non-productive yearlings in the population. Further, success rates in the 3½- and 4½-year-old age-classes should decline, due to alternate year production. Therefore, reduced productivity during 1978-79 is anticipated.

Survival of Marked Deer

Three hundred and two white-tailed deer have been captured and marked for individual recognition during the three winters of this study. Of these, 125 deer were known to be alive at the time of spring dispersal 1978. Forty-four marked deer have been known mortalities. The remaining 133 marked deer have not been accounted for.

Of the 115 deer, which were marked during winter 1976, 82 were known survivors through spring 1976, 49 through spring 1977, and 27 through spring 1978. Sixty-nine deer were marked during winter 1977. Of these, 36 were known survivors through spring 1977 and 17 through spring 1978. One hundred and eighteen deer were marked during winter 1978. Of these, 81 were known survivors through spring 1978.

Known mortalities from the 1976 sample included: 14 hunting mortalities, of which five occurred during 1976 and nine occurred during 1977; six road-kills, of which one, two, and three were lost during 1976, 1977, and 1978, respectively; one coyote kill during winter 1976; three winter kills, of which one was lost during 1976 and two were lost during 1977; one deer was poached during winter 1977; and, one deer died from undetermined causes during fall 1976. Known mortalities from the 1977 sample included: two deer harvested during the 1977 hunting season; five road-kills, of which two were lost during winter 1977 and three were lost during winter 1978; one coyote kill during each of the winters, 1977 and 1978; one winter kill during 1977; and, one deer died from an undetermined cause during summer 1977. Mortalities from the 1978 sample included three road-kills, two coyote kills, and two from undetermined causes. In summary, known mortalities included 16 hunter kills, 14 road-kills, five coyote kills, four winter kills, one poaching loss, and four losses from undetermined causes.

The fate of 62 deer from the 1976 sample has not been determined. Of these, 30 have not been observed since they were marked, 22 were observed during 1976 but not thereafter, and 10 were observed in 1977 but not in 1978. Forty-one deer from the 1977 sample have not been accounted for. Of these, 28 have never been observed and 13 were observed in 1977 but not in 1978. Thirty deer from the 1978 sample have not been observed. That 133 deer have not been accounted for probably resulted from the loss of collars and undetected mortalities. Further, certain deer may have been captured while they were occupying transient ranges. The latter is suggested because deer which were captured during late winter predominate in the category of unobserved

deer. Also, a large percentage of the 1977 sample was never observed. During that winter, spring-fall range was occupied (Mundinger 1977).

Preliminary estimates of survival rates can be developed from the histories of marked cohorts. Twenty-three male fawns were marked during 1976. Of these, a minimum of 16 (70 percent) survived to 12 months, six (26 percent) survived to 24 months, and one (four percent) survived to 36 months. Known mortalities accounted for eight (35 percent) of this cohort. Fourteen (61 percent) of these deer had not been accounted for as of spring 1978.

Eighteen female fawns were marked in 1976. Fourteen (78 percent) were known survivors through 12 months, and all of these deer also survived through 24 months. Eight (44 percent) survived through 36 months. Four (22 percent) from this cohort were known mortalities, and six (33 percent) remain unaccounted for.

Nine yearling females were marked in 1976. Of these, seven (78 percent) survived to 24 months and six (67 percent) survived to 36 months. Five (56 percent) were known mortalities and four (44 percent) remain unaccounted for. Ten 2½-year-old females were marked in 1976. Of these, seven, six, and five were known survivors through 36, 48, and 60 months, respectively. No known mortalities occurred within this cohort and five of these deer remain unaccounted for.

Fifteen male fawns were marked during winter 1976. Of these, six (40 percent) and two (13 percent) survived through 12 and 24 months, respectively. Two (13 percent) were known mortalities and 11 (73 percent) remain unaccounted for.

Seventeen female fawns were marked during 1977. Of these, 13 (76 percent) and nine (53 percent) survived through 12 and 24 months, respectively. One (six percent) was a known mortality and seven (41 percent) remain unaccounted for.

Winter Distribution and Range Use

The major white-tailed deer winter range in the upper Swan Valley extends from Goat Creek south to Condon Creek, a distance of approximately 12 miles. The western flood plain of the Swan River and a line, approximately one mile east of and parallel to Highway 209, establish the breadth of the winter range. It also extends into the major tributaries of the Swan River, particularly Cedar Creek, on the west side and Squeezer, Lion, Pony and Dog Creeks on the east side.

Five habitat types dominate the winter range. Habitat type nomenclature follows the classification of Montana forest types (Pfister et al. 1977). The *Picea/Clintonia uniflora* H. T. occurs along the bottoms of the Swan River and its tributaries and adjacent to potholes and marshes. The *Pseudotsuga menziesii/Calamagrostis rubescens* and *Pseudotsuga menziesii/Symphoricarpos albus* H. T.'s occur on the drier upland sites. The *Abies grandis/Clintonia uniflora* and *Abies lasiocarpa/Clintonia uniflora* H. T.'s occur on the moist upland sites.

Winter observations of white-tailed deer typically occurred within closed-canopy stands of mature sub-climax forest. These stands supported a mixture of species. Douglas fir (*Pseudotsuga menziesii*), in various combinations with western larch (*Larix occidentalis*) and lodgepole pine (*Pinus contorta*), dominated. On certain upland sites ponderosa pine (*Pinus ponderosa*) also was well represented. Spruce (*Picea* spp.) was a dominant species on the more mesic sites. These species, except spruce, are important components of seral communities within the major habitat types of the winter range.

Timbered mesic sites and timbered uplands appeared to be integral components of the white-tailed deer winter range. Distinct concentrations of deer occurred along the bottoms of the Swan River and its tributaries and adjacent to potholes and marshes. Deer also used the uplands consistently, although this use was diffuse. Association between mesic areas and uplands was indicated by the patterns of the major trails. The home ranges of individual deer each contained both of these habitat components. Mesic areas seemed to provide security, while the uplands provided forage.

Winter range was characterized by habitat diversity and interspersion. Interspersion best described the timbered margins of mesic areas, the timbered uplands, and the interrelation between mesic areas and uplands. Topographic variation, e.g. ridges adjacent to stream bottoms, further contributed to habitat diversity.

Use of clear-cuts during winter was minor and restricted to the timbered margins. Exceptions to this occurred during the mild 1977 winter (Mundinger 1977). The clear-cuts which were used that year were on early spring-late fall range, but outside of the boundary of the normal winter range.

Differences in distributions and range use, between winters were noted. During all winters, the Swan River and its tributaries were distinct focal use areas. During the 1978 winter, deer were more restricted to these bottoms (Fig. 1). This area was used during 1977; other areas, as shown in Figure 1, also were used. Use of uplands was more extensive during 1977. The 1976 winter range boundary was intermediate to 1977 and 1978 (Mundinger 1977). These differences were related to differences in depth and duration of the snow cover. Snow persisted from late December through the end of March during 1976 and 1978, with snow depths of approximately 18 to 24 inches during 1976 and 30 to 36 inches, and occasionally more, during 1978. In 1977 the snow cover was less persistent and depths of 12 inches rarely occurred. Certain areas frequently were bare of snow.

Food Habits

Food habits of white-tailed deer during the fall period were determined by the examination of contents of rumens, including one from November 1976 and six collected during September through November, 1977. Winter food habits were determined by analysis of 16, 26, and 47 rumen samples collected during December-March, 1976, 1977, and 1978, respectively. Spring food habits were determined from three and four rumen samples collected during April 1976 and 1977, respectively. Plant nomenclature for the food habits tables is included in Table 17.

Figure 1. White-tailed deer winter range boundary in the upper Swan River Valley during 1977 and 1978.

Figure 1 (Continued).

Table 17. Plant nomenclature used in food habits tables.

Abbreviation	Nomenclature	Common Name
Conifers		
ABGR	*Abies grandis*	Grand fir
JUCO	*Juniperis communis*	Common juniper
LAOC	*Larix occidentalis*	Western larch
PISP	*Picea* spp.	Spruce
PICO	*Pinus contorta*	Lodgepole pine
PIPO	*Pinus ponderosa*	Ponderosa pine
PSME	*Pseudotsuga menziesii*	Douglas Fir
THPL	*Thuja plicata*	Western red cedar
Shrubs		
ACGL	*Acer glabrum*	Mountain maple
ALIN	*Alnus incana*	Thinleaf alder
AMAL	*Amelanchier alnifolia*	Western serviceberry
ARUV	*Arctostaphylos uva-ursi*	Kinikinnik
BERE	*Berberis repens*	Oregon grape
BESP	*Betula* spp.	Birch
CESA	*Ceanothus sanguineus*	Redstem ceanothus
CEVE	*Ceanothus velutinus*	Snowbrush ceanothus
COST	*Cornus stolonifera*	Red dogwood
HODI	*Holodiscus discolor*	Mountain spray
PAMY	*Pachistima myrsinites*	Myrtle pachistima
POSP	*Populus* spp.	Cottonwood
RHAL	*Rhamnus alnifolia*	Alder buckthorn
ROSP	*Rosa* spp.	Rose
RUPA	*Rubus parviflorus*	Thimbleberry
SASP	*Salix* spp.	Willow
SHCA	*Shepherdia canadensis*	Canadian buffalo-berry
SPBE	*Spiraea betulifolia*	White spiraea
SYAL	*Symphoricarpos albus*	Common snowberry

Table 17. (Continued).

Forbs		
ADBI	*Adenocaulon bicolor*	Trail-plant
ANSP	*Antennaria* spp.	Pussytoes
CHUM	*Chimaphila umbellata*	Common pipsissewa
CISP	*Cirsium* spp.	Thistle
COCA	*Cornus canadensis*	Bunchberry dogwood
ERGR	*Erythronium grandiflorum*	Dogtooth lily
GOOB	*Goodyera oblongiflora*	Rattlesnake plantain
FRVI	*Fragaria virginiana*	Strawberry
HASP	*Hackelia* spp.	Stickseed
LIBO	*Linnaea borealis*	Twin-flower
PESP	*Penstemon* spp.	Penstemon
PLMA	*Plantago major*	Broad leaf plantain
PYSP	*Pyrola* spp.	Pinedrops
THOC	*Thalictrum occidentale*	Meadow rue
TRSP	*Trifolium* spp.	Clover
XETE	*Xerophyllum tenax*	Beargrass
Others		
ALSP	*Allectoria* spp.	Tree-moss
EQSP	*Equisetum* spp.	Horsetail

Browse, forbs, grasses, and other materials comprised 66, 14, one, and 20 percent, respectively, of the fall diet (Table 18). Oregon grape (*Berberis repens)* was the predominant forage item. This species occurred in six of the seven samples, at an average of 35 percent by volume. Serviceberry (*Amelanchier alnifolia)* and snowberry (*Symphoricarpos albus)* were other important deciduous browse species. Douglas fir was the only important coniferous species in the diet, although its occurrence was considerably less than its occurrence in the winter samples. Bunchberry dogwood (*Cornus canadensis)* was the predominant forb. This species occurred in three of the samples with an average of ten percent of the volume. Twin-flower (*Linnaea borealis)* also occurred in three samples, with an average of one percent. Hay was the only predominant item in the other category. This material occurred in one sample, in which it comprised 87 percent of the volume. Mushrooms appeared in four of the samples, comprising an average of four percent by volume.

Browse, forbs, grasses, and other materials comprised 89, three, two, and five percent, respectively, of the diet, during the three winters (Tables 19, 20, 21, 22, and 23). Douglas fir was the predominant coniferous species. Other important conifers included common juniper (*Juniperis communis),* spruce, and lodgepole pine. Of the deciduous species, Oregon grape was the only predominant item. Serviceberry, kinikinnik (*Arctostaphylos uva-ursi)* and snowbrush ceanothus (*Ceanothus velutinus)* also occurred frequently. Twin-flower was the only important forb. This species occurred in 21 percent of the samples and averaged two percent of the diet. Tree-moss (*Allectoria* spp.) apparently was an important item in the winter diet, as white-tailed deer frequently were observed to feed on this material. The importance of this taxon was difficult to determine from rumen analysis. Use of tree-moss was indicated either by its presence or the presence of larch bark in the rumen samples. Apparently, deer also forage in the duff layer of the forest. Such items as lichens, moss, mushrooms, and dry leaves of various deciduous species regularly occurred. Although the percentage of these materials in the diet was small, the frequency of occurrence suggested that these materials were taken intentionally. As with tree-moss, these items probably are readily digestible. Therefore, their importance in the diet was under-estimated by rumen analysis.

Important differences in the diet were noted between winters. Browse was the predominant forage class during all winters, but the composition of the browse diet changed between winters. Deciduous species, particularly Oregon grape, predominated during 1976 and 1977; coniferous species, particularly Douglas fir, predominated in 1978. Spruce and lodgepole pine frequently occurred in the 1978 samples, while these species were minor items in the diet during the previous two winters. Use of kinikinnik declined during 1978. The use of forbs and grasses was greatest during 1977, and twin-flower was an important item that winter. The use of forbs and grasses declined during 1978. These classes were replaced in the diet by other material, particularly hay. The use of hay reflected both deer feeding on hay stacks and a greater number of Swan Valley residents feeding deer. The importance of hay in the diet probably was biased because most of the animals in the sample were road-kills, and most haystacks and feed-grounds occurred near the highway. The differences in food habits between winters probably reflected differences in depth and duration of snow cover. Apparently, white-tailed deer preferred to

Table 18. Fall food habits of white-tailed deer on the Upper Swan Valley, as determined by rumen analyses.

Taxon	1976(1)[1] Percent	1977(6) Frequency	1977(6) Percent
ABGR		0.17	tr[2]
JUCO		0.17	0.4
LAOC	0.5		
PICO		0.67	0.4
PIPO		0.17	0.1
PSME	0.1	0.50	4.6
Total Conifer	0.6	0.83	5.5
ACGL	tr		
AMAL	tr	0.50	4.2
BERE	68.8	0.83	29.3
BESP		0.17	0.5
CEVE	7.7		
PAMY	1.0		
RHAL	0.1		
RUPA		0.17	0.1
SASP		0.50	0.2
SYAL	tr	0.50	10.2
Unid. Browse		0.33	13.8
Total Browse	77.6	1.00	58.3
Conifer & Browse	78.2	1.00	63.7
ADBI	tr		
CISP	1.4		
COCA		0.50	11.4
FRUI		0.33	0.5
LIBO	6.8	0.33	0.5
PESP	0.7		
XETE	0.5		
Unid. Forbs	0.9	0.83	2.1
Total Forbs	10.3	0.83	14.6

Table 18. (continued).

Grasses		0.67	1,5
ALSP	9.0		
Larch Bark	1.4	0.33	0.1
Hay		0.17	14.6
Dry Leaves		0.33	0.8
Moss		0.17	tr
Mushroom	tr	0.50	4.3
Seeds	tr	0.33	1.1

[1] Sample site in parentheses.

[2] tr = trace, less than 0.1 percent.

Table 19. December food habits of white-tailed deer in the Upper Swan Valley, as determined by rumen analyses.

Taxon	1975(3)[1] Frequency	1975(3)[1] Percent	1976(3) Frequency	1976(3) Percent	1974(4) Frequency	1974(4) Percent
ABGR			0.33	0.8		
JUCO	1.00	20.4	0.67	2,9	0.50	28.2
PISP					0.25	1.7
PICO	0.67	0.4			1.00	5.7
PSME	1.00	8.5	0.67	7.7	1.00	43.4
Total Conifer	1.00	29.3	1.00	11.4	1.00	79.0
ACGL	0.67	2.1	0.33	0.2		
ALIN	0.67	tr[2]				
AMAL	0.67	1.7	0.67	0.3	1.00	4.6
ARUV	1.00	4.4			0.25	1.1
BERE	1.00	27.1	1.00	43.0	0.75	0.4
BESP					0.25	0.1
CESA	0.33	tr				
CEVE	1.00	1.7	1.00	2.1	0.50	2.0
HODI			0.33	32.0		
POSP	0.33	0.5				
ROSP	0.33	tr			0.50	tr
SASP	1.00	7.9				
SPBE	1.00	0.7				
SYAL	0.33	0.4				
Unid. Browse	1.00	7.9	0.33	0.3	0.75	9.4
Total Browse	1.00	54.4	1.00	77.8	1.00	17.5
Conifer & Browse	1.00	83.7	1.00	89.2	1.00	96.4
ADBI			0.33	0.2		
ANSP	0.33	tr				
CHUM	0.33	0.1	0.33	2.3		
CISP			0.67	4.8		
GOOB	0.33	2.1				
LIBO	0.33	tr				

Table 19. (Continued).

XETE	0.67	2.2	0.33	2.2		
Unid. Forbs	1.00	0.9	0.67	0.3	0.25	1.3
Total Forbs	1.00	5.3	1.00	9.7	0.25	1.3
Grasses	0.67	9.6			0.50	0.8
ALSP	0.33	0.3			0.25	0.4
Larch Bark	0.67	0.2	1.00	1.1	0.50	0.5
EQSP	0.33	0.1				
Dry Leaves					1.00	0.7
Mushroom	0.33	0.8				

[1] Sample size in parentheses.

[2] tr = trace, less than 0.1 percent.

Table 20. January food habits of white-tailed deer in the Upper Swan Valley, as determined by rumen analyses.

Taxon	1976(3)[1] Frequency	1976(3)[1] Percent	1977(1) Percent	1978 (13) Frequency	1978 (13) Percent
ABGR				0.08	0.2
JUCO	1.00	28.5		0.15	0.1
LAOC	0.33	1.7			
PISP				0.46	5.4
PICO	1.00	2.0		0.85	3.6
PIPO	0.67	0.6			
PSME	1.00	10.2	11.8	1.00	54.8
THPL				0.08	6.4
Total Conifer	1.00	43.0	11.8	1.00	71.1
ACGL			0.3		
ALIN	0.67	tr[2]			
AMAL	1.00	3.2	0.5	0.54	1.4
ARUV	1.00	6.9			
BERE	1.00	6.7	6.1		
CESA	0.67	3.5			
CEVE	0.67	2.6		0.46	1.9
COST				0.08	0.3
POSP	0.33	0.1	tr		
ROSP	0.33	0.1	1.4		
SASP				0.23	1.4
SHCA	0.33	0.1			
SPBE	0.33	1.6			
SYAL	0.33	tr	tr		
Unid. Browse	1.00	24.8	72.0	0.54	9.4
Total Browse	1.00	49.5	80.3	0.85	14.6
Conifer & Browse	1.00	92.5	92.1	1,00	85.7
CISP			5.3		
XETE			1.5		

Table 20. (Continued).

Unid. Forbs	1.00	2.2			
Total Forbs	1.00	2.2	6.8		
Grasses				0.15	0.2
ALSP	0.67	3.2		0.23	0.3
Larch Bark	0.67	1.3	0.4	0.46	0.7
Dry Leaves				0.23	0.1
Hay				0.15	12.8
Lichen				0.23	0.1
Moss	0.33	tr			
Mushroom	0.67	0.8	0.7		

[1] Sample size in parentheses.

[2] tr = trace, less than 0.1 percent.

Table 21. February food habits of white-tailed deer in the Upper Swan Valley, as determined by rumen analyses.

Taxon	1976(4)[1] Frequency	1976(4)[1] Percent	1977 (10) Frequency	1977 (10) Percent	1978 (16) Frequency	1978 (16) Percent
ABGR	0.25	1.9				
JUCO	0.75	5.2	0.40	0.5		
LAOC			0.10	0.1	0.13	1.1
PISP					0.56	10.1
PICO	0.75	0.4	0.50	0.9	0.81	4.9
PSME	0.75	1.9	0.90	29.3	1.00	64.3
THPL	0.25	17.3				
Total Conifer	1.00	26.5	1.00	30.8	1.00	80.5
ACGL			0.10	0.1		
ALIN	0.50	0.2	0.10	tr[2]		
AMAL	0.50	2.7	0.70	3.8	0.56	1.3
ARUV	0.75	2.5	0.60	3.3		
BERE	1.00	22.5	0.90	37.7		
BESP	0.25	0.5	0.50	0.2		
CEVE	0.75	1.7	0.70	1.5	0.19	0.1
COST			0.20	0.4		
PAMY	0.25	tr	0.10	tr		
POSP			0.20	1.1		
RHAL					0.13	tr
ROSP			0.40	1.4	0.19	0.2
SASP	0.50	1.1	0.20	0.3	0.19	0.2
SHCA	0.25	0.2				
SPBE	0.75	0.8	0.40	0.3		
SYAL			0.10	0.7		
Unid. Browse	0.75	27.8	0.80	14.6	0.31	5.6
Total Browse	1.00	60.0	1.00	65.0	0.75	7.6
Conifer & Browse	1.00	86.6	1.00	95,7	1.00	88,1
CHUM	0.50	0.6	0.20	0.2		
CISP			0.20	tr		

Table 21. (Continued).

HASP					0.06	1.3
LIBO	0.25	0.3	0.30	1.9		
XETE	0.75	1.1	0.20	0.5		
Unid. Forbs	0.25	2.5	0.40	0.4	0.06	tr
Total Forbs	1.00	4.5	1.00	3.1	0.13	1.7
Grasses	0.25	tr	0.10	0.4	0.25	0.1
ALSP					0.31	4.7
Larch Bark	0.50	6.5	0.40	0.3	0.63	1.4
EQSP			0.10	tr		
Dry Leaves					0.31	0.2
Hay					0.31	4.0
Lichen	0.25	tr	0.20	0.1	0.19	tr
Moss	0.50	2.6			0.06	tr
Mushroom			0.20	0.1	0.13	0.2

[1] Sample size in parentheses.

[2] tr = trace, less than 0.1 percent.

Table 22. March food habits of white-tailed deer on the Upper Swan Valley, as determined by rumen analyses.

Taxon	1976(6)[1] Frequency	1976(6)[1] Percent	1977(12) Frequency	1977(12) Percent	1978(14) Frequency	1978(14) Percent
JUCO	0.50	1.8	0.42	1.0	0.21	0.4
LAOC			0.17	0.1	0.07	0.1
PISP			0.08	0.1	0.14	4.6
PICO	0.67	1.3	0.67	3.0	0.93	8.0
PSME	1.00	3.8	0.92	9.0	1.00	57.8
THPL	0.17	0.7	0.08	tr[2]		
Total Conifer	1.00	7.7	1.00	13.1	1.00	70.9
ACGL	0.17	tr	0.08	tr		
ALIN	0.83	0.4				
AMAL	0.67	0.6	0.42	0.4	0.43	0.9
ARUV	0.33	3.8	0.83	2.9	0.71	1.4
BERE	1.00	80.6	0.92	53.3	0.64	21.2
BESP			0.17	tr	0.29	0.1
CEVE	0.67	0.7	0.33	1.2	0.29	0.3
COST			0.08	0.1		
PAMY	0.33	0.6				
POSP			0.17	0.2		
ROSP	0.17	tr	0.08	tr		
SASP	0.83	0.7	0.33	0.3	0.14	tr
SHCA					0.07	tr
SPBE	0.50	0.2	0.33	0.2		
SYAL					0.07	tr
Unid. Browse	0.67	1.9	0.83	4.6	0.57	1.9
Total Browse	1.00	89.3	1.00	63.0	1.00	25.8
Confer & Browse	1.00	96.9	1.00	76.1	1.00	96.7
CHUM	0.17	0.1	0.50	1.2	0.07	tr
FRVI	0.17	0.1			0.07	tr
LIBO	0.50	0.4	0.75	9.7	0.14	0.1
PYSP			0.17	0.1		

Table 22. (Continued).

THOC					0.07	tr
TRSP			0.17	tr	0.14	0.1
XETE	0.86	1.8	0.25	1.4		
Unid. Forbs	0.17	0.2	0.33	0,9	0.21	tr
Total Forbs	1.00	2.5	1.00	13.3	0.29	0.5
Grasses	0.33	0.1	0.67	6.8	0.57	1.7
ALSP	0.17	tr	0.25	2.0	0.14	0.1
Larch bark	0.17	0.2	0.50	1.3	0.29	0.1
EQSP	0.17	tr	0.08	tr		
Dry Leaves			0.33	0.4	0.50	0.3
Hay					0.29	0.7
Lichen					0.07	tr
Moss	0.17	0.1				
Mushroom	0.33	0.2	0.08	0.1	0.29	0.1

[1] Sample size in parentheses.

[2] tr = trace, less than 0.1 percent.

Table 23. Winter food habits of white-tailed deer in the Upper Swan Valley, as determined by rumen analyses.

Taxon	1976(16)[1] Frequency	1976(16)[1] Percent	1977(26) Frequency	1977(26) Percent	1978(47) Frequency	1978(47) Percent
ABGR	0.06	0.5	0.04	0.1	0.02	0.1
JUCO	0.75	11.1	0.42	1.0	0.15	2.6
LAOC	0.06	0.3	0.12	0.1	0.06	0.4
PISP			0.04	tr	0.38	6.4
PICO	0.75	1.0	0.50	1.7	0.87	5.5
PIPO	0.13	0.1				
PSME	0.94	5.4	0.88	16.7	1.00	58.0
THPL	0.13	4.6	0.04	tr[2]	0.02	1.8
Total Conifer	1.00	23.1	1.00	19.7	1.00	74.9
ACGL	0.19	0.4	0.15	0.1		
ALIN	0.69	0.2	0.04	tr		
AMAL	0.69	1.8	0.58	1.7	0.55	1.5
ARUV	0.69	4.1	0.62	2.6	0.23	0.5
BERE	1.00	42.2	0.92	44.3	0.26	6.3
BESP	0.06	0.1	0.27	0.1	0.11	tr
CESA	0.06	tr				
CEVE	0.69	1.5	0.54	1.4	0.32	0.9
COST			0.12	0.2	0.02	0.1
HODI			0.04	3.7		
PAMY	0.19	0.2	0.04	tr		
POSP	0.13	0.1	0.19	0.5		
RHAL					0.04	tr
ROSP	0.19	tr	0.23	0.5	0.11	0.1
SASP	0.63	2.0	0.23	0.2	0.17	0.5
SHCA	0.13	0.1			0.02	tr
SPBE	0.63	0.7	0.31	0.2		
SYAL	0.13	0.1	0.08	0.3	0.02	tr
Unid. Browse	0.83	13.8	0.77	10.6	0.53	5.9
Total Browse	1.00	68.0	1.00	66.1	0.87	15.8

Table 23 (Continued).

Conifer & Browse	1.00	91.0	1.00	85.8	1.00	90.7
ADBI			0.04	tr		
ANSP	0.06	tr				
CHUM	0.25	0.2	0.35	0.9	0.02	tr
CISP			0.19	0.8	0.02	tr
FRVI	0.06	tr				
GOOB	0.06	0.4				
HASP					0.02	0.5
LIBO	0.31	0.2	0.46	5.2	0.04	tr
PYSP			0.08	tr		
THOC					0.02	tr
TRSP			0.08	tr	0.04	tr
XETE	0.63	1.4	0.27	1.1		
Unid. Forbs	0.44	1.3	0.38	0.6	0.11	0.1
Total Forbs	1.00	3.5	1.00	8.7	0.13	0.5
Grasses	0.31	1.8	0.35	3.3	0.34	0.7
ALSP	0.25	0.7	0.12	0.9	0.23	1.7
Larch Bark	0.44	2.0	0.54	0.8	0.47	0.8
EQSP	0.13	tr	0.08	tr		
Dry Leaves			0.15	0.2	0.32	0.2
Hay					0.23	5.1
Lichens	0.06	tr	0.08	tr	0.13	0.1
Moss	0.25	0.7			0.02	tr
Mushroom	0.19	0.2	0.15	0.1	0.13	0.1
Seeds	0.06	tr				

[1] Sample size in parentheses.

[2] tr = trace, less than 0.1 percent.

forage on the low-growing, evergreen Angiosperms, particularly Oregon grape, kinikinnik, twin-flower, and bear grass (*Xerophyllum tenax*), if these materials were available. However, snow cover restricted these items from the diet.

Browse, forbs, grasses, and other material comprised 88, nine, one, and one percent, respectively, of the April diet (Table 24). Oregon grape was the predominant item in the spring diet, and the greatest use of this species occurred during that season. Other important deciduous species included serviceberry, kinikinnik, and Myrtle pachistima (*Pachistima myrsinites*). Common juniper and Douglas fir were the important coniferous species, although the use of conifers greatly decreased in the spring diet, as compared to use during winter. The use of forbs increased from winter to spring, although forbs were less important in the spring diet as compared with fall food habits. Twin-flower and bear grass were the only prominent forbs in the spring diet.

Winter food habits during 1976-78 generally were consistent with those reported for 1957 (Weckwerth 1958) and 1970 (Hildebrand 1971). Species composition in the diet was similar, except for the lack of snowbrush ceanothus in the 1957 samples. A greater percentage of Oregon grape occurred in the 1976 and 1977 samples, as compared with 1957 and 1970. Bergeson (1943) did not present quantitative food habits data. He did indicate that the majority of food consumed was Douglas fir and tree-moss. Use of willow, mountain maple (*Acer glabrum*), serviceberry, ceanothus (species not indicated), and common juniper also was indicated. Oregon grape, huckleberry (*Vaccinium* spp.), and kinikinnik also were used during periods of reduced snow cover. Present data are consistent with these observations.

Home Range

Relocations of 47 collared deer were sufficient to provide estimates of their respective winter home range areas. The rectangular areas which included all observations of each individual were assumed to represent the winter home ranges. These ranged from eight to 205 acres, with a mean of 51 acres (s.e. = 45). These values were smaller than those recorded during previous winters (Mundinger 1977).

The probable home range perimeters of 17 radio-equipped deer were plotted on aerial photographs. These had been determined from observations, frequent fixes, and a general knowledge of deer use in the respective areas. Home range areas of these deer ranged from 47 to 205 acres, with a mean of 98 acres (s.e. = 44). Home range areas of radio-equipped deer averaged 122 and 150 acres during 1976 and 1977, respectively.

The radio-equipped deer typically evidenced an affinity for a small area within their home ranges. Two deer, which occupied the largest winter home ranges, each had two such areas of intensive use.

The winter home ranges of three radio-equipped deer were determined during three successive winters. Deer 4-76 (Fig. 2) occupied an area of approximately 230 acres during 1977. This area included the 1976 home range of 156 acres and the 1978 home range of 47 acres. Deer 60-76 (Fig. 3) used

Table 24. April food habits of white-tailed deer in the Upper Swan Valley, as determined by rumen analyses.

Taxon	1976(3)[1] Frequency	1976(3)[1] Percent	1977(4) Frequency	1977(4) Percent
JUCO			0.50	4.3
LAOC			0.25	1.3
PICO	0.67	1.0	0.75	0.9
PSME	1.00	19.4	0.50	tr
Total Conifer	1.00	20.4	1.00	6.4
ACGL	0.33	0.4		
ALIN	1.00	0.7		
AMAL	1.00	5.3	0.50	0.1
ARUV	0.67	2.0	0.75	4.0
BERE	1.00	37.8	1.00	76.5
BESP			0.50	tr
CESA			0.25	tr
CEVE	1.00	0.9		
COST			0.25	tr
PAMY	0.67	14.2	0.25	0.2
SASP	0.33	0.4		
SPBE	0.33	tr		
Unid. Browse	0.67	7.0	0.25	0.6
Total Browse	1.00	68.7	1.00	81.3
Conifer & Browse	1.00	89.2	1.00	87.7
CHUM			0.25	0.1
ERGR	0.67	0.2		
FRVI			0.25	0.1
LIBO	0.33	0.3	0.75	8.9
PLMA	0.33	0.3		
TRSP			0.25	tr
XETE	0.67	6.5		
Unid. Forbs	0.67	1.5	0.50	0.7
Total Forbs	1.00	8.7	1.00	9.7
Grasses	0.67	2.0		

Table 24 (Continued).

Larch Bark			0.25	0.3
EQSP			0.25	1.8
Dry Leaves			0.25	0.2
Moss			0.50	tr
Mushroom	0.33	0.3		

[1] Sample size in parentheses.

[2] tr = trace, less than 0.1 percent.

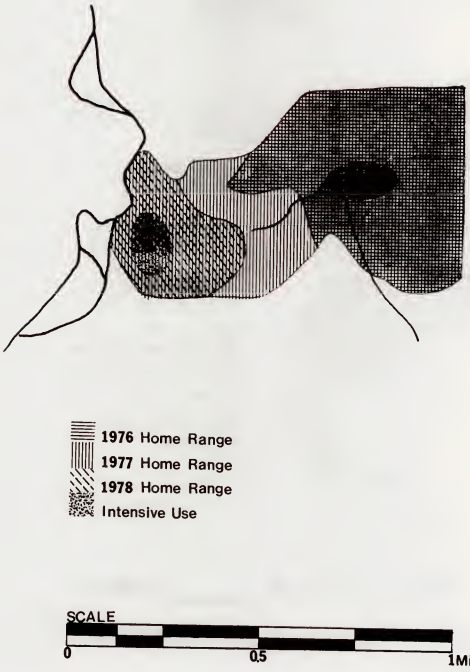

Figure 2. Winter home range of deer 4-76.

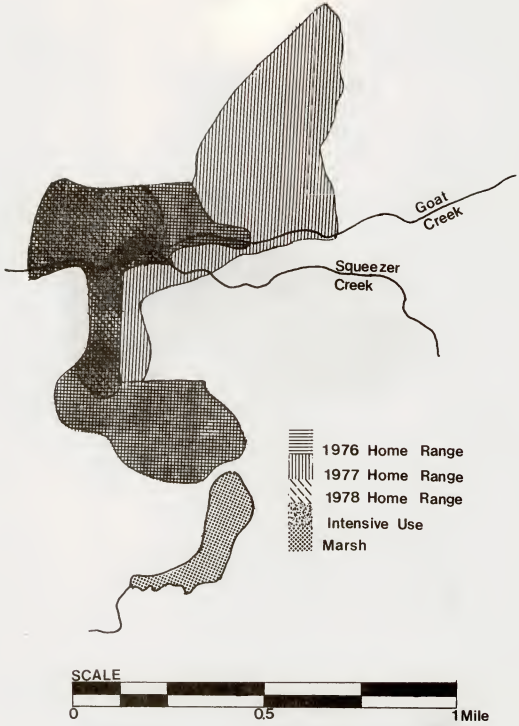

Figure 3. Winter home range of deer 60-76.

280 acres in 1977, of which 148 acres had been used in 1976. The 1978 winter home range of 119 acres was contained in the 1976 home range. Deer 36-76 (Fig. 4) occupied a similar area of 144 acres during 1976 and 1977. In 1978 she occupied an area of 71 acres that was outside of the boundary of her previous winter home range. However, that area had been occupied in early winter and again in early spring.

The winter home ranges of two radio-equipped deer were determined during 1977 and 1978. Deer 23-77 used approximately the same home range, an area of 128 acres, during both winters. Deer 25-77 (Fig. 5) occupied approximately 115 acres during 1977. During 1978 she used a home range of 95 acres that was not included in her 1978 home range.

Movements

Summer dispersal of radio-equipped deer is presented in Figures 6 through 12. Nine deer were followed during 1976. Nine deer, four of which were included in the 1976 sample, were monitored during 1977. The 1978 sample contained 19 deer, of which four were in the 1976 sample and three were in the 1977 sample. Deaths and transmitter failures had reduced the sample to eight deer by August 1978.

Deer 4-76 (Fig. 6) was captured as an old adult female in January 1976. She wintered west of Van Lake, near the Swan River. During 1976 and 1977 she was closely associated with an intermittent creek bottom, while in 1978 she wintered at the lower end of this creek, on the Swan River bottom. Typically, she remained on her wintering area through mid-April and returned in mid-December. Her summer range was located near Lindbergh Lake, approximately 22 miles south of her winter range. This area was characterized by several meadows interspersed with mature timber. The transmitter on this deer failed during June 1978. This deer had been confused with a grizzly bear which carried a similar transmitter and the previous report of her movements (Mundinger 1977) was in error.

Deer 4-77 was a 1976 offspring of deer 4-76. She and her litter-mate were captured as fawns in January, 1977. Deer 4-77 was recaptured and equipped with a transmitter in 1978. Her 1978 wintering area coincided with her mother's. Her summering area also was similar. These deer remained closely associated during winter 1978 but the association seemed to wane by early April. The two deer moved separately to Lindbergh Lake.

Deer 27-76 (Fig. 7) was captured west of Van Lake in January, 1976. At that time she was 2½-years-old. During 1976 and 1977 she wintered near the trap site and was associated with a large pothole. She returned to this pothole in early winter 1978. Thereafter, she was associated with the Swan River bottom, approximately one mile west of the pothole. During each year her summer range was occupied from early May through mid-December. Her summer location was closely associated with a large, irregular shaped meadow on the ridge above the Swan River, approximately two miles east of Lindbergh Lake and 21 miles south of her wintering area. The transmitter on this deer failed in July, 1978.

Figure 4. Winter home range of deer 36-76.

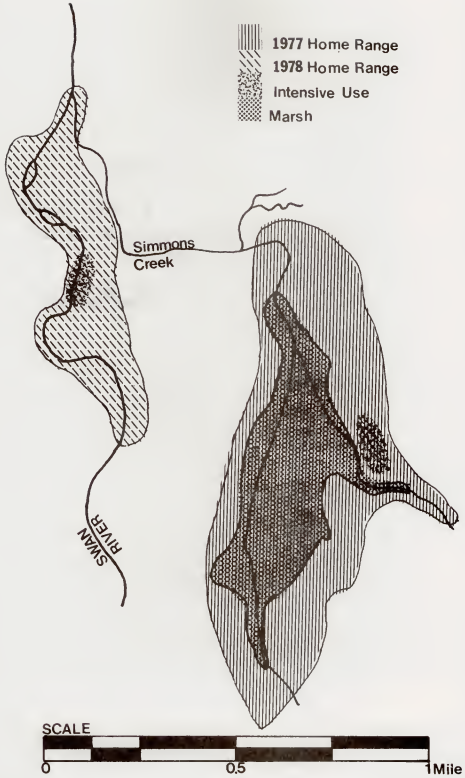

Figure 5. Winter home range of deer 25-77.

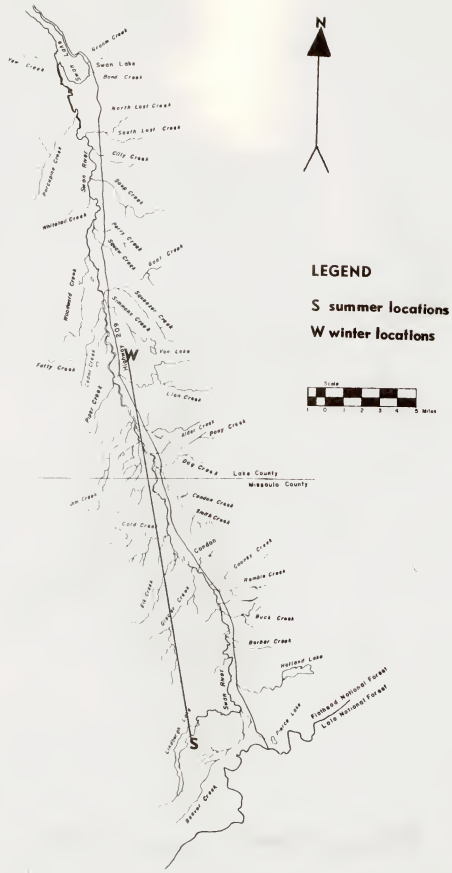

Figure 6. Movements of deer 4-76, as determined from 1976, 1977 and 1978 relocations.

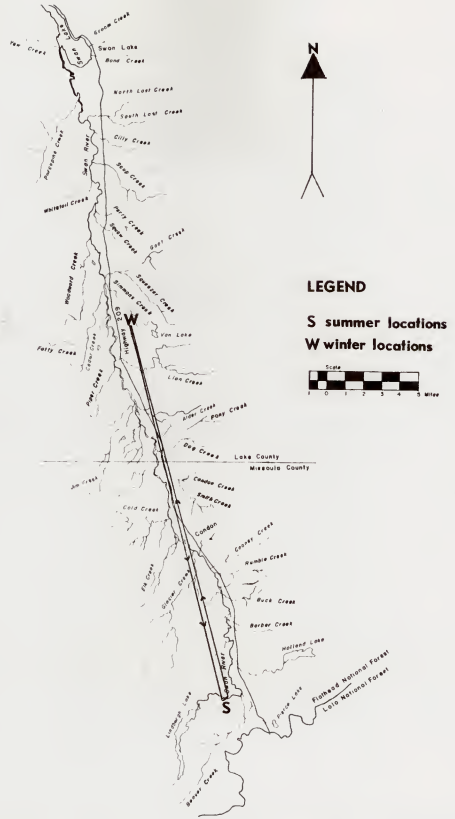

Figure 7. Movements of deer 27-76, as determined from 1976, 1977, and 1978 relocations.

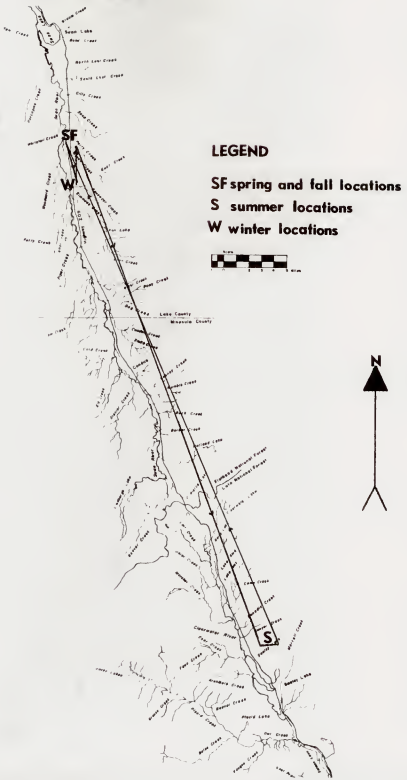

Figure 9. Movements of deer 60-76, as determined from 1976 and 1977 relocations.

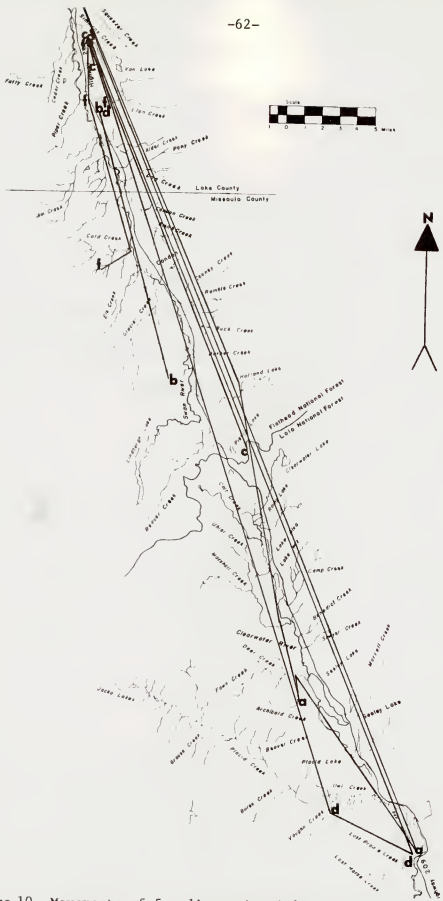

Figure 10. Movements of 5 radio-equipped deer during 1976.

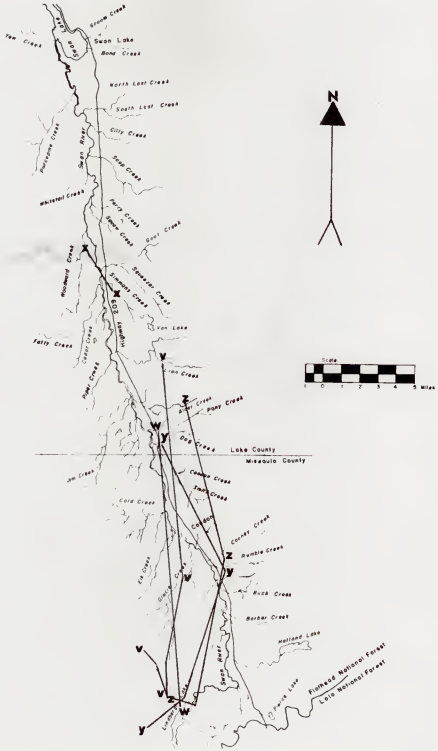

Figure 11. Movements of 5 radio-equipped deer during 1977.

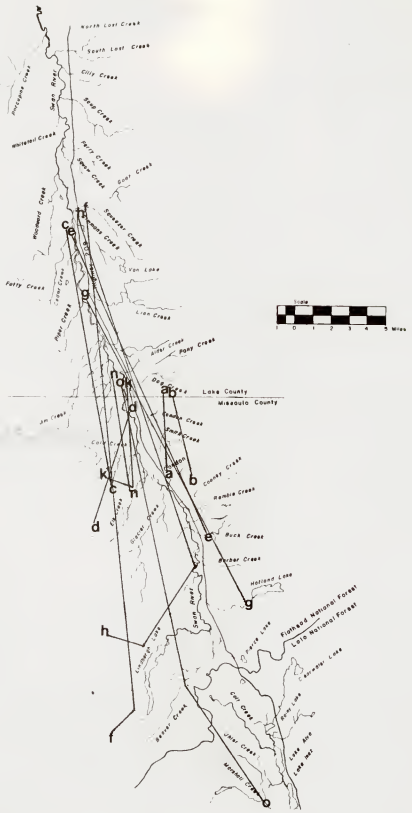

Figure 12. Movements of 11 radio-equipped deer during 1978.

Deer 36-76 (Fig. 8), a 3½-year-old female, was captured in January, 1976 near the Lion Creek Road. Following the capture, she moved about two miles east and wintered in Lion Creek canyon. She wintered in a similar area during 1977. In 1978 she first returned to this area, then wintered in Squeezer Creek, approximately three miles north of the Lion Creek area. The trap site of this deer occurred in an area which she typically occupied during December and April - mid-May. She summered in Placid Creek, a tributary of the Clearwater River, near its junction with Grouse Creek. The transmitter on this deer failed in July, 1978.

Deer 60-76 (Fig. 9) was captured near the State Forest Headquarters at Goat Creek in March, 1976. At that time, her age was estimated at 4½-years. During 1978, her winter range was restricted to the timbered bottoms near the junction of Goat and Squeezer Creeks. Her 1976 and 1977 winter locations also were associated with this bottom. However, in 1977 she used the uplands, north of Goat Creek and south of Squeezer Creek, extensively. Her 1976 wintering area was intermediate to that used in 1977 and 1978. This deer used a spring-fall range, which was located in Squaw Creek, approximately three miles north of her wintering area. This area was occupied during early April - mid-May in 1976 and 1977, during late September - mid-December, 1976, and November - mid-December in 1977. She summered in Rice Creek, east of Seeley Lake, approximately 38 miles south of her wintering area and 41 miles south of Squaw Creek. The transmitter on this deer failed in early April, 1978.

Deer 50-76 (Deer a in Fig. 10) was captured as an old adult female in Goat Creek in March 1976. She remained in Goat Creek until early April. She was relocated near Holland Lake in early May, in Marshall Creek during late May, in Archibald Creek during late June through early August, and in Fawn Creek through late September. Approximately 39 miles separated her summering and wintering areas. This deer could not be relocated from October through December, however she was observed in mid-December near the Salmon Lake Winter Range (Janke pers. comm.). She returned to her Goat Creek wintering area by late January 1977. This deer died from an undetermined cause during late winter.

Deer 96-76 (Deer b in Fig. 10) was captured, as a 3½-year-old-female, in late March 1976 near the Lion Creek Road. She remained near the trap site for about 2 weeks. During early May through late November she was relocated near the Kraft Creek Road, approximately 15 miles south of her trapsite. This deer died from an undetermined cause during late fall.

Deer 9-76 (Deer c in Fig. 10) was captured, as an old adult female, near Van Lake in January 1976. She moved approximately 1 mile north and spent the winter in Simmons Creek. She had left her wintering area by mid-April. Subsequently, she was relocated in Condon Creek in early May and near Pierce Lake, approximately 22 miles south of Simmons Creek, during late May through June. Thereafter, her transmitter failed. She was observed in early April 1977 within her 1976 wintering area.

Deer 24-76 (Deer d in Fig. 10) was captured, as a 4½-year-old-female, near the Lion Creek Road in January 1976. Subsequently, she moved approximately 4 miles north to Simmons Creek, where she remained until mid-April. She was

not relocated until late June. At that time she was in Vaughn Creek, southeast of Placid Lake, approximately 44 miles south of her wintering area. This deer remained in Vaughn Creek until mid-October, at which time her transmitter failed. This deer was observed near the Salmon Lake Winter Range in mid-December (Janke Pers. Comm.) and in Simmons Creek in winter 1977 and 1978.

Deer 23-76 (Deer f in Fig.10) was captured, as a yearling female, near the Lion Creek Road in January 1976. She moved approximately 4 miles north to Simmons Creek, where she remained until mid-March. This deer returned to the vicinity of her trap site during late March through mid-April. During May she was relocated near the junction of Cold Creek and the Swan River. During June through mid-August she was relocated in the South Fork of Cold Creek, approximately 12 miles south of her wintering area, and 4 miles southeast of the mouth of Cold Creek. She has not been relocated since, and it is assumed that her transmitter failed.

Deer 68-76 (Deer v in Fig. 11) was captured, as a male fawn, in Lion Creek Canyon in March 1976. He was recaptured in Lion Creek Canyon several times during 1977, and equipped with a transmitter in March. This deer remained in Lion Creek Canyon through early May. During June through August he was relocated at various sites within the Glacier Creek drainage. He then moved into upper Hemlock Creek, a tributary of Glacier Creek, where he remained until late October. The approximate mid-point of his summer relocations was 17 miles south of his wintering area. This deer was harvested in lower Glacier Creek in November.

Deer 23-77 (Deer w in Fig. 11) was captured as a 3½-year-old female, in Pony Creek in early February, 1977. She remained in the general vicinity of her trap site until early May. She was relocated near Lindbergh Lake, approximately 15 miles south of Pony Creek, in early June. Thereafter, she could not be relocated until she returned to Pony Creek in early January, 1978. At that time her transmitter was still functioning. Her 1978 winter range was similar to that used in 1977. This deer was killed by a car in May, 1978.

Deer 25-77 (Deer x in Fig. 11) was captured, as a yearling female, at Simmons Meadow in early February, 1977. She remained near Simmons Meadow until early April. She summered near Metcalf Lake, approximately three miles northwest of Simmons Meadow. During early winter 1978 she was located on the Swan River bottom near Cedar Creek, between Metcalf Lake and Simmons Meadow. During 1978, she wintered on the river bottom near the confluence of Simmons Creek.

Deer 43-77 (Deer y in Fig. 11) was captured, as a 3½-year-old female, in Dog Creek in early March 1977. She remained in Dog Creek through early April. She was relocated in Rumble Creek in mid-April, near Lindbergh Lake from late April through early June, and in Glacier Creek, approximately 16 miles south of Dog Creek, during late June through mid-July. This deer died from an undetermined cause in late July.

Deer 56-77 (Deer z in Fig. 11) was captured, as a 2½-year-old female, in mid-March, 1977 in Alder Creek. She was relocated in Rumble Creek during mid-April and near Lindbergh Lake during late April through June, 1977.

Thereafter, she summered in Glacier Sloughs, approximately 17 miles south of her trap site. She returned to Alder Creek in December, 1977, thence moved five miles north and wintered in Squeezer Creek. She returned to Alder Creek where she remained during April, 1978. During May she was located in lower Glacier Creek and she returned to Glacier Sloughs by early June. Thereafter, her transmitter failed.

Deer 6-78 (Deer a in Fig. 12) was captured, as a 5½-year-old female, in Dog Creek during January, 1978. She wintered with a large group of deer that was associated with an active timber sale and remained in this area through late March. She was located in lower McKay Creek, near the Condon Ranger Station, during mid-April - May. This area was approximately five miles south of her wintering area. This deer died from an undetermined cause in late May.

Deer 56-78 (Deer b in Fig. 12), a 3½-year-old female, was captured with a female fawn, in early February, 1978. These deer also were associated with the Dog Creek timber sale. This deer was located in Falls Creek in early April and had occupied her summer range, in McKay Creek, by mid-April. Her summer range was approximately six miles southeast of her winter range.

Deer 26-78 (Deer c in Fig. 12), a 3½-year-old female, was captured in mid-January, 1978. She wintered on the Swan River bottom near Cedar Creek. She remained in this area through late March. She was not located during April. By mid-May she had occupied her summer range, in the South Fork of Cold Creek, approximately 15 miles south of her winter range.

Deer 35-78 (Deer d in Fig. 12), a yearling female, was captured in lower Dog Creek in late January, 1978. She wintered in lower Condon Creek, about one-half mile south of the trap site. During April she returned to the vicinity of the trap site. In early May she was found in lower Elk Creek. She was located in the South Fork of Cold Creek, approximately seven miles southwest of her winter range, during mid-may - June. Thereafter, she could not be relocated.

Deer 39-78 (Deer e in Fig. 12), a 4½-year-old female, was captured in late January, 1978. She wintered on the Swan River bottom, near Cedar Creek. In early April she was located near Simmons Meadow and was found in Alder Creek in late April. By early May, she was established in her summer range in lower Buck Creek, approximately 19 miles south of Cedar Creek.

Deer 41-78 (Deer f in Fig. 12), a 3½-year-old female, was captured in early February, 1978. She wintered on Goat Creek bottom near its junction with Squeezer Creek. During April - mid-May, she was found in Goat Creek, approximately one-and-one-half miles east of her winter home range. By late May she was found at Meadow Lake, and by early June she was established on her summer range. She summered on the Swan River bottom near Crystal Lake, southwest of Lindbergh Lake. Approximately 29 miles separated her summer and winter ranges.

Deer 44-78 (Deer g in Fig.12), a 2½-year-old female, was captured in early February, 1978. She wintered on Lion Creek bottom, near its confluence with the Swan River. She remained in the vicinity of Lion Creek through April. Thereafter, she was found at Holland Lake, approximately 19 miles southeast of her winter range. This deer was killed, probably by coyotes, in late May.

Deer 48-78 (Deer h in Fig.12), a 2½-year-old female, was captured in Goat Creek in early February, 1978. This deer was unusually mobile during the winter. Winter relocations were obtained in Goat, Squeezer, Simmons, and Cedar Creeks. She remained in this area through early April. During mid-April - May she was located on the Swan River bottom, south of Barber Creek. In early June she was found near Lindbergh Lake. Thereafter, she was established on her summer range in Kraft Creek, approximately seven miles southwest of the Swan River location and 23 miles south of her winter range.

Deer 50-78 (Deer k in Fig.12), a yearling female, was captured in early February, 1978. She wintered in lower Dog Creek, and remained in this vicinity through April. During May, she was found at various locations in lower Elk Creek. By early June, she was established on her summer range in Cold Creek, approximately five miles southwest of her winter range. After mid-July the deer was not relocated.

Deer 59-78 (Deer n in Fig.12), a 3½-year-old female, was captured in Dog Creek in early February, 1978. Thereafter, she was found on the Swan River bottom near Pony Creek, approximately one mile northwest of the trap site. She remained in that vicinity through April. By early May she was established on her summer range in lower Elk Creek, approximately six miles south of her winter range. The transmitter on this deer may have failed by mid-June.

Deer 63-78 (Deer o in Fig.12), a yearling female, was captured in early February, 1978. She wintered in lower Pony Creek, where she remained through March. She was found in Smith Creek in early April. During mid-April - early June she occupied an area in Beaver Creek. By mid-June she was established on her summer range in Marshall Creek, approximately seven miles southeast of the Beaver Creek location and 25 miles south of Pony Creek.

These movements indicated that white-tailed deer behaved as individuals. Each deer occupied a recognizable summer and winter range, and each was faithful to these areas. Certain deer occupied distinguishable transitional ranges during spring and/or fall. Others apparently were able to satisfy their spring and fall range requirments within their winter and/or summer ranges. Movements did not occur as large migrations. Rather, each deer moved as an individual. When the movement occurred also was an expression of individual behavior. Mackie and Knowles (1977) indicated that mule deer in the Bridger Mountains also move, as individuals between seasonal ranges.

Summer Range Use

White-tailed deer summer throughout the Swan Valley at low to mid-elevations. Movements of marked deer indicated that the majority of deer from the Goat Creek-Dog Creek area summer between Condon and the Swan-Clearwater divide, south of the winter range. A portion of this herd summers in the Clearwater

drainage. Deer also summer between Swan Lake and Goat Creek. It is presumed that a portion of these deer winter in Goat Creek-Dog Creek, however, marked animals have not been associated with this area.

Summer range use was determined by monitoring the radio-equipped deer. These animals were periodically located by fixed-wing flights. This information was supplemented with ground reconnaisance. During 1978 these deer frequently were ground-tracked and the respective summer home ranges were mapped. The 1978 data are not yet tabulated.

Certain similarities in range use patterns, by individual deer, were noted. Each summering area was typified by closed-canopy forest. A mixture of coniferous species generally was present, but the species composition was not consistent between sites. A habitat classification has not been completed, but several types were represented. Further, a variety of cover types, representing various successival stages, also was present. Habitat and cover types probably were less important than the mere presence of dense coniferous cover.

Also consistent between summer home ranges was the presence of small, natural openings and wet sites. These typically occurred as creek bottoms, marshy creek bottoms, potholes, marshes, and meadows. These sites were integral to the individual summering areas. Similar to winter range, these mesic areas appeared to be focal areas of the summer range. The importance of habitat interspersion also was evident on summer range.

Evidence of old fires frequently was encountered. The ecological role of fire on white-tailed deer range needs further investigation.

Recent cut-over areas were included in the summer home ranges of certain deer. The greatest use of these areas apparently was confined to the edges. Natural openings and wet sites, from which all adjacent timber had been removed, were not attractive to deer.

Movements of radio-equipped deer suggested distinct summer concentrations of white-tailed deer within the Glacier Creek and Beaver Creek drainages of the Swan River and the headwaters of the Clearwater River. This observation was consistent with the harvest distribution and hunter returns of marked deer (Figs. 13 and 14). This area is typified by a high density of mesic sites and extensive mature forest. Fire probably regenerated most of this area. Recent logging has been more intensive north of Kraft Creek, a tributary of Glacier Creek, and south of Colt Creek, a northern tributary of the Clearwater River.

LITERATURE CITED

Bergeson, W. R. 1943. Swan Valley deer study. Unpub. Montana Fish and Game Dept., Helena. Quart. Rept. 33 p. Mimeo.

Firebaugh, J. E., D. L. Flath, and K. G. Knoche. 1975. Deer-railroad relationship study. Final Report. U. S. Army Corps of Engineers, Contract No. DACW-67-C-0036. Mont. Dept. Fish and Game, Helena. 24 pp. Multilith.

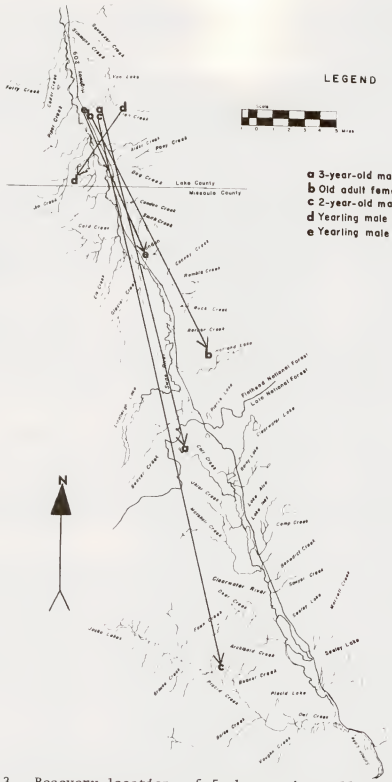

Figure 13. Recovery locations of 5 observation-collared deer during the 1976 hunting season.

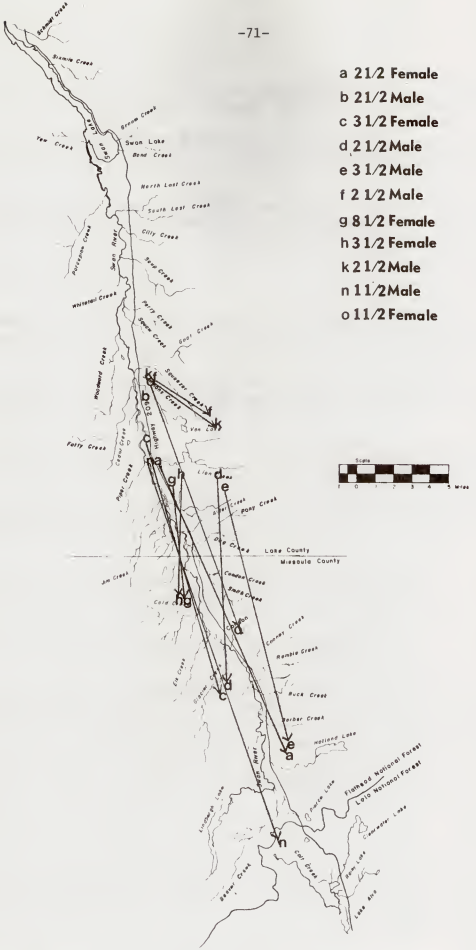

Figure 14. Recovery locations of 11 observation-collared deer during the 1977 hunting season.

Gilbert, F. F. 1966. Aging white-tailed deer by annuli in the cementum of the first incisor. J. Wildl. Manage. 30(1):200-202.

Hildebrand, P. R. 1971. Biology of white-tailed deer on winter ranges in the Swan Valley, Montana. Unpub. M. S. Thesis. Univ. Montana, Missoula. 91 pp.

Janke, D. 1977. White-tailed deer population characteristics, movements, and winter site selection in western Montana. Unpub. M. S. Thesis, Univ. Montana, Missoula. 92 pp.

Mackie, R. J. 1964. Montana deer weights. Montana Outdoors. Winter, 1964. Pp. 9-14.

_____., K. L. Hamlin, and J. G. Mundinger. 1976. Habitat relationships of mule deer in the Bridger Mountains, MT. Job Prog. Rept., Montana Dept. Fish and Game, Fed. Aid Proj. W-120-R-6 (Supplement). 46 pp.

_____., and C. J. Knowles. 1977. Population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana. Job Prog. Rept. Montana Dept. Fish and Game, Fed.Aid Proj. W-120-R-8. Pp. 47-72.

Martin, A. C., R. H. Gensch, and C. P. Brown. 1946. Alternative methods in upland game bird food analysis. J. Wildl. Manage. 10(1):8-12.

Mundinger, J. G. 1976. Population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of northwestern Montana. Job Prog. Rept., Montana Dept. Fish and Game, Fed. Aid Proj. W-120-R-7. Pp. 7-37.

_____. 1977. Population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of northwestern Montana. Job Prog. Rept., Montana Dept. Fish and Game, Fed. Aid Proj. W-120-R-8. Pp. 5-43.

O'Pezio, J. P. 1978. Mortality among white-tailed deer fawns on the Seneca Army Depot. New York Fish and Game Journal. 25(1):1-15.

Overton, W. S. and D. E. Davis. 1969. Estimating the numbers of animals in wildlife populations. Pp. 403-455. *In:* R. H. Giles (Editor) Wildlife Management Techniques. 3rd ed. Printed for the Wildlife Society by Edwards Brothers, Inc. Ann Arbor, Michigan. 623 pp.

Pfister, R. D , B. L. Kovalchick, S. F. Arno, and R. C. Presby. 1977. Forest habitat types of Montana. U.S.D.A. Forest Service. Gen. Tech. Rept. INT-34. 174 pp.

Quimby, D. C. and J. E. Gaab. 1957. Mandibular dentition as an age indicator in Rocky Mountain elk. J. Wildl. Manage. 21(4):435-451.

Robinette, W. L., D. A. Jones, G. Rogers, and J. S. Gashwiler. 1957. Notes on tooth development and wear for Rocky Mountain mule deer. J. Wildl. Manage. 21(2):134-153.

Severinghaus, C. W. 1949. Tooth development and wear as criteria of age in white-tailed deer. J. Wildl. Manage. 13(2):195-216.

Verme, L. J. 1962. Mortality of white-tailed deer fawns in relation to nutrition. Pp. 15-38. *In:* Proc. Natol. White-tailed Deer Disease Symp., I. Univ. Georgia, Athens.

_____. 1967. Influence of experimental diets on white-tailed deer reproduction. Trans. N. A. Wildl. Conf. 32:405-420.

_____. 1969. Reproductive patterns of white-tailed deer related to nutritional plane. J. Wildl. Manage. 33(4):881-887.

_____. 1977. Assessment of natal mortality in upper Michigan deer. J. Wildl. Manage. 41(4):700-708.

Weckwerth, R. 1958. Big game surveys and investigations - Swan Unit. Job Prog. Rept., Fed. Aid Proj. W-71-R-3. Montana Dept. Fish and Game. 21 pp.

Wilkins, B. T. 1957. Range use, food habits, and agricultural relationships of the mule deer, Bridger Mountains, Montana. J. Wildl. Manage. 21(2): 159-169.

Submitted By; John G. Mundinger

JOB TITLE: White-tailed deer population characteristics, movements, and winter site selection in western Montana.

JOB OBJECTIVE: The project's primary objectives were to determine population characteristics and describe the sites used by white-tailed deer on the Salmon Lake winter range in the Clearwater River drainage in west-central Montana.

Findings:

Field work was completed during the spring of 1977 and the Final Thesis Report was submitted as a separate supplement to the 1976-77 Deer Studies Report for investigation on the population ecology and habitat relationships of white-tailed deer in coniferous forest habitat of western Montana. An abstract of the thesis by Douglas Janke is presented below.

ABSTRACT:

White-tailed deer (Odocoileus virginianus) wintering in the Salmon Lake area of western Montana were studied from October 1975 to September 1977. Intensive study from January through March in 1976 and 1977 was intended to determine the population characteristics and food habits of deer wintering at Salmon Lake as well as to determine the factors influencing habitat selection on the winter range. Study during other months was directed toward identifying summer locations of these deer.

Analyses of population characteristics of these deer included determination of numbers, sex and age ratios, mortality, reproduction, physiological condition, and physical measurements. Between 400 and 550 deer used the 19.06 square-kilometer (7.36 sq mi) winter range. Fawn:adult ratios for 1976 and 1977 were 47:100 and 53:100, respectively, indicating good fawn survival. Bucks comprised 65 percent of the adult harvest during either-sex hunting. Hunter harvest was the major mortality factor. Less than one-third of the population was harvested each year. Winter mortality was minimal. Deer were not suffering from severe malnutrition. Conception dates ranged from 23 November to 4 December.

Analysis of food habits indicated grasses and forbs were preferred. Shrubs receiving the greatest utilization included Oregon grape (Berberis repens), chokecherry (Prunus virginiana), serviceberry (Amelanchier alnifolia), and Rocky Mountain maple (Acer glabrum).

Topo-cover types with steep slopes and moderate snow cover were used extensively. Slopes that developed snow-free areas adjacent to dense overstory cover were also preferred. Intensive studies of the potential of broadcast burns for rehabilitating the winter range should be initiated.

Summer locations were obtained for eight deer. These deer migrated an average distance of 13.99 kilometers (8.69 mi) from the winter range.

Job Title White-tailed deer movements, survival and population characteristics in the Clearwater River drainage, Montana.

ABSTRACT

A study of white-tailed deer, initiated in the Clearwater River drainage during 1975, was continued during winter, spring and summer 1978. Objectives, procedures, and work accomplished during the latter period are described.

Job Title: White-tailed deer movements, survival and population characteristics in the Clearwater River drainage, Montana.

Job Objective: To determine and describe:

1. Summer distribution of white-tailed deer which winter in the Salmon Lake area of the Clearwater drainage.
2. The status, i.e., numbers and trend, fawn production and survival, and mortality factors affecting this deer population.
3. Seasonal food habits.
4. Winter range condition.
5. The potential effects of logging on deer habitats and population in the Clearwater River drainage.

INTRODUCTION:

A study of white-tailed deer wintering in the Salmon Lake area of the Clearwater River drainage in western Montana was initiated in October 1975 (Janke 1977). The first segment of this study was completed in March 1977 with results reported by Janke (1977). The present study continues the investigation through the summer of 1978. Field work was conducted full time during the winter of 1977-78 and from June through September 1978 and part-time during spring, 1978.

PROCEDURES:

1. A review of literature and history of the area was undertaken by Janke (1977). These materials will be reviewed and some additional review of specific items will be done as necessary in relation to procedures and findings of this study.
2. A habitat type map following the criteria of Pfister et al. (1977) was developed during the first study. This map will be used during subsequent surveys on the winter range and will be extended to summer use areas.
3. Continue trapping and marking deer on "Camp Nine" winter concentration area. Approximately 55 deer were marked during the past two winters, and about 40 tagged deer are believed to remain in the population. Seven deer were radioed, and five transmitters are still operating. Additional deer should be radioed and old transmitters replaced when possible.

4. Conduct systematic aerial searches and ground surveys at appropriate intervals during the year to locate marked animals, and to sex-age classify representative samples of the population. Little field classification was possible during the past two years because of mild winter weather and scattered deer distribution.

5. Intensify efforts to collect jaws of tagged animals, especially those tagged as fawns, for age determination criteria.

6. Maintain records of weather observations, particularly snow depths and hardness, in relation to deer activity and habitat type use. Little was done on this item because of shallow snow depths during the past two years.

7. Make systematic search for dead animals and maintain records of location, cause of death, condition, sex and age, and other pertinent details. Few dead animals were found during the past two winters because of light mortality during the mild winters.

8. Obtain additional food habits data by feeding site examination and collection of rumen samples. Data from the past two winters reflect food habits during mild winters which may differ from findings during more severe winters.

9. Continue evaluation of condition, productivity and utilization of winter range forage. The extent of winter range under varying snow conditions should be determined.

10. Obtain deer production data by collecting reproductive tracts from deer killed by traffic, predators, and other causes.

11. Determine hunting harvest, sex age composition, and physical characteristics of harvested deer.

RESULTS

During winter, 1978, 34 deer were trapped on the Salmon Lake winter range. Seven of these were recaptures of previously-collared deer. The remaining 27 deer were collared and ear-tagged. Three of these deer were radio-collared. There are currently eight radio-collared deer on the study area.

Snow depths were recorded every two weeks along a series of established snow courses on the study area.

White-tailed deer mortality during the winter included one deer killed by a mountain lion and five killed by automobiles. Stomach content samples were taken for food habits analysis. Femur marrow was examined. Fetus numbers, lengths, and sexes were noted.

Browse transects established previously on the study area were measured during the spring.

Deer summer ranges have been identified and will be habitat typed during the summer of 1978. Radio-collared deer are periodically relocated and their movements monitored throughout the study.

LITERATURE CITED

Janke, D. M. 1977. White-tailed deer population characteristics, movements, and winter site selection in western Montana. Unpubl. Masters Thesis, Univeristy of Montana, Missoula. 92pp.

Pfister, R.D., B.L. Kovalchik, S.F. Arno and R.C. Presby. 1977. Forest habitat types of Montana. USDA For. Serv. Gen. Tech. Rpt. INT-34. 174pp.

Submitted by: Barbara Slott

Job Title Population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana.

ABSTRACT

This report describes studies on the population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana, with emphasis on investigations and findings from July 1, 1977 through June 30, 1978. Emphasis is also given to population studies of mule deer associated with the Armstrong winter range, conducted from 1971-72 through 1978; though information concerning the distribution and population characteristics of mule deer throughout the Bridger Mountain complex is also presented and described. Aerial surveys during winter, conducted regularly since 1971 along the west slope, and less regularly since 1974 over the remainder of the Bridger Range, have defined 7 major winter ranges totaling approximately 90,000 acres (140 mi^2). These include 3 along the west slope (south end, 9.0 mi^2; north end, 4.87 mi^2; and Blacktail Mountain, 3.6 mi^2), 3 along the east side (Battle Ridge, 27.7 mi^2; Brackett Creek, 38.5 mi^2; and Livingston, 28.8 mi^2), and the south 16-Mile winter range, about 25.2 mi^2, located at the north end of the Bridger Range. Several, smaller and less defined local areas may also be used by small numbers of mule deer. Major ranges differ with respect to topographic, climatic and vegetational characteristics, especially between the west slope, east side, and north end areas collectively. Distributional data suggest that mule deer associated with individual winter ranges may comprise herd or population units which occupy rather distinct and definable herd ranges within the Bridger Mountain complex. Population data for the Armstrong range indicated that about 220 mule deer were present during early winter; the number decreasing to about 160 animals in late winter. Overwinter mortality, during the relatively severe winter, was moderate to heavy, resulting in loss of more than 25 percent of all deer including nearly 50 percent of the fawns present in early winter. The observed fawn:female ratio for early winter was 47:100, the highest recorded on the area since early winter 1971-72. However, by April the ratio decreased to an estimated 27 fawns:100 does, which was lower than previous years except 1975 and 1976. The numbers and proportion of adult females in the early winter population increased from 1976-77 while numbers of adult males continued to decline. The age structure of the population, differential longevity and mortality rates between the two sexes, and heavy harvest of males were defined as possible causes of these trends. A total of 3,259 mule deer was counted and classified on winter ranges within the Bridger Mountain complex during early winter 1977-78. Consideration of numbers observed in past years and the efficiency of aerial surveys indicated that more deer occurred than were counted on all areas. Estimates placed the total at about 4,500 mule deer, or about 10/mi^2 of yearlong range in the Bridger complex. Data indicated differences in density distributions of mule deer between winter ranges with the suggestion that density varied inversely with the amount of winter range available. Highest densities occurred on restricted west slope ranges, while the lowest were found on extensive, open east side areas. Population data indicated general increases in mule deer populations to early winter 1977-78 in most areas but especially on the east side and the north end of the Bridger complex; however, overwinter losses may have negated the increase on west slope ranges and dampened increases on the east side and north end. Populations associated with individual ranges as well as generally between

west slope, east side and north end portions of the Bridger Mountains were shown to differ with respect to sex and age composition in 1977-78 as well as previous years. West slope ranges have populations characterized by high proportions of males and relatively low proportions of fawns. East side and north end populations have included low numbers of males and generally high, but more variable, proportions of fawns. These differences supported the indication that mule deer associated with individual winter ranges may comprise discrete population units associated with distinct herd ranges.

Job Title — Population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana.

Job Objective — To determine the environmental requirement of mule deer and factors regulating mule deer populations in mountain-foothill habitats of southwestern Montana.

To determine the effects of various potentially competing land use and management practices upon mule deer in southwestern Montana.

To develop new and improved guidelines for management of southwestern Montana mule deer populations and their habitats.

INTRODUCTION

The Bridger Range is one of several "island"-type mountain ranges which provide superior habitat for mule deer in central and southwestern Montana. It's importance in the management of mule deer in the state is exemplified by the fact that this range produced an average harvest of more than 2,300 (1,768-4,145) mule deer annually from 1957 through 1974 (Mackie et al. 1976), or about 2.8 percent of the statewide total. Mackie (1978) suggested that mule deer occur at generally higher population densities in complex, highly diverse mountain-foothill habitats such as the Bridger Range than in other habitats in which they may be found in the northern Rocky Mountains and Great Plains.

Ecological studies of mule deer in the Bridger Mountains were initiated in 1955, when Wilkins (1957) conducted a one-year (1955-56) investigation of the range use, food habits, and agricultural relationships of deer associated with the Armstrong winter range (Fig. 1). Subsequently, from 1957 to 1971, when the present study was initiated, investigations were limited to periodic observations and winter range surveys. The latter included measurement of key browse utilization and condition trend transects and deer-proof exclosures established on the Armstrong area in 1955 and on Brackett Creek in 1962.

Studies concerning population trends and dynamics and habitat relationships of mule deer in the Bridger Range were established and have been conducted continuously since the winter of 1971-72. Initially, efforts were directed to (1) obtaining population data for mule deer wintering along the west slope of the Bridgers from Bozeman to Pass Creek (Fig. 1), with emphasis on the Armstrong winter range; (2) a study comparing range use and food habits of mule deer on the Armstrong range during 1972-73 (Schwarzkoph 1973) with those described by Wilkins (1957); and (3) a study of the ecological characteristics of the Armstrong range, including production and utilization of important browse plants (Bucsis 1974). Subsequently, Hamlin (1974) and Pac (1976) evaluated the distribution, movements and range use of mule deer associated with the Armstrong winter range during spring, summer and fall; Morton (1976) studied nutritional

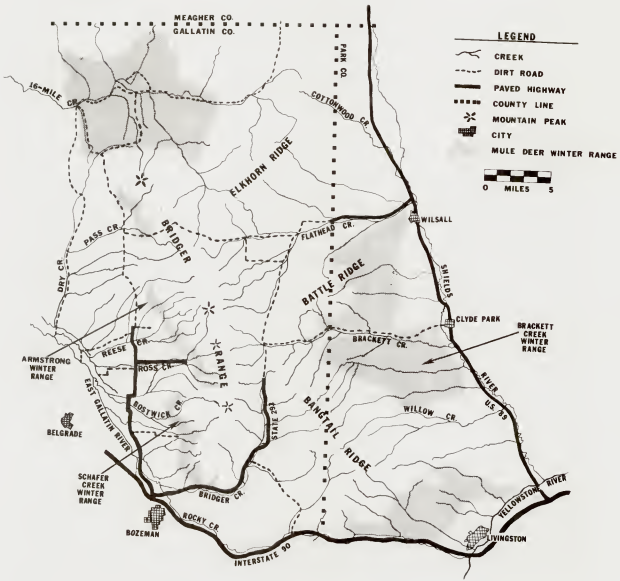

Figure 1. Map of the Bridger Range showing major features and the location of primary study areas.

values of major winter forage plants and the production-availability of important herbaceous forages; and Youmans (1977, In Prep.) conducted an intensive investigation of mule deer movements and behavior on the Armstrong winter range. Mackie et al. (1976), Mackie and Stewart (1976), Mackie and Knowles (1977), Hamlin (1977) and Mackie (1978) have reported and discussed results of population studies on the Armstrong area from 1972 through 1977.

Beginning during the 1974-75 winter, population studies were extended to include mule deer wintering throughout the entire Bridger Mountain complex. This effort defined winter distribution and ranges on the north end of the Range, on the southwest slope of Blacktail Mountain and in the 16-Mile Creek Basin, and refined winter distributions reported by Constan (1975) for mule deer wintering on the east side of the Range, in the vicinity of Battle Ridge, along Brackett and Canyon Creeks, and near Livingston on the southeast slope of Bangtail Ridge (Fig. 1). In addition, it provided information on numbers of deer generally utilizing the different winter ranges, sex and age (fawn:female and fawn:adult) composition, and, in some cases, fawn survival through the winter.

In the summer of 1975, the Bridger Mountain mule deer studies were included in the Statewide Deer Research program which involved comparative investigations on the population ecology and habitat relationships of both mule deer and white-tailed deer in all of the major ecological or broad habitat types on which the two species occur in Montana. At the same time a special study, to determine the effect of coyote control on survival of mule deer fawns (Schladweiler 1975, 1976, 1977, 1978), was established on a portion of the 16-Mile Creek winter range, which included all of the area north of 16-Mile Creek and its Middle Fork (Fig. 1). During the following winter, mule deer were trapped and neckbanded on the Schafer Creek area (Fig. 1), where, in 1976-1978, intensive studies were conducted to compare the distribution, movements, range use and population characteristics of mule deer between this area and the Armstrong Range (Steerey 1977, In Prep.).

Studies to classify the vegetation and develop habitat type maps of all major mule deer winter ranges in the Bridger Mountains were initiated in the summer of 1976 (Jorgensen 1977). In the spring-summer of 1978, these studies were expanded to measure and characterize in as much detail as possible all environmental characteristics of the Bridger Mountain complex as they may influence the distribution, density and dynamics of mule deer. Partly in relation to this study, and partly to compare distributional, movement, habitat use and popualtion characteristics of mule deer between west and east slope ranges, an intensive study of mule deer associated with the Brackett Creek winter range was established during the 1977-78 winter (Nyberg 1978).

This report updates and generally summarizes findings concerning the population ecology and habitat relationships of mule deer in the Bridger Mountains through spring and early summer 1978. Emphasis is given to information obtained for mule deer on the primary study area, the Armstrong range; though data obtained for other populations are presented, comparatively, where appropriate. Results of special, intensive studies on local areas are or will be reported separately as progress reports (Nyberg 1978) or supplementary final thesis reports (Youmans, Steerey, In Prep.).

ACKNOWLEDGEMENTS

Studies of mule deer in the Bridger Mountains have been conducted with the cooperation and assistance of the Montana Department of Fish and Game, Region 3, and the U. S. Forest Service, Gallatin National Forest and Bozeman Ranger District. The willingness of numerous private landowners throughout the Bridger Range to allow access to their lands and in many cases their direct assistance in various aspects of the studies has been a major factor both in enabling the work to be done and in results achieved. Murray Duffy, Central Helicopters, Bozeman, and James Stradley, Gallatin Flying Service, Belgrade, both contributed extensively through their flying and observational skills in helicopter and fixed wing aerial surveys, respectively. Much credit is also due to all of the many individual Montana Department of Fish and Game personnel and Montana State University graduate and undergraduate students who have participated in one way or another in the studies, and without whose help much of the work could never have been accomplished.

THE STUDY AREA

The Bridger Mountain Range (Figs. 1 and 2) is located in northeastern Gallatin and northwestern Park Counties, Montana. The total study area, encompassing the Bridger Range complex and adjacent foothills, prairie and agricultural lands used by or available to deer, includes a land area of approximately 800 square miles. It is bounded on the west by the East Gallatin River, Dry Creek and the Dry Creek-Maudlow road; on the north by 16-Mile Creek, its Middle Fork, and Cottonwood Creek; on the east by U. S. Highway 89 and the Shields River; and on the south by the Yellowstone River and Interstate Highway 90 between Livingston and Bozeman. A portion of the 16-Mile Creek winter range extends north of this boundary to the Gallatin-Meagher County line. Whether deer associated with that north portion of the 16-Mile winter range move south from the Big Belt Mountains or include some animals from the Bridger complex is not known at this time.

The Bridger Mountain complex includes the main Bridger Range which extends north and west in a gently curving arc from Bridger Canyon to Blacktail Mountain, a distance of about 23 miles (McMannis 1955). It also includes Elkhorn Ridge, which extends northeast off the northern portion of the main range, and Battle and Bangtail Ridges, which extend northeast and southeast, respectively, from about the center of the range. Topographic and geological features of the Bridger Range have been described by McMannis (1955). Elevations on the study area range from about 4,600 ft. along 16-Mile Creek in the northwestern corner of the area to 9,665 ft. Highest elevation and the most severe and complex topography occur along the main Bridger Range; while easterly extending ridges and drainages are of lower (less than 7,600 ft.) and less severe relief (Fig. 2).

To date, our studies have centered on the Armstrong winter range and adjacent spring-summer-fall ranges used by deer associated with that area, which includes primarily that portion of the main Bridger Range extending from Flathead Pass south to Ross Pass. Vegetational and other "habitat" and environmental characteristics of much of this area have been described in detail by Bucsis (1974) and Pac (1976). Steerey (In Prep.) has described vegetational attributes of yearlong ranges used by mule deer associated

Figure 2. Map of Bridger Range showing topographical features in relation to location of major winter range (shaded areas). Dots indicate location of weather stations.

with the Schafer Creek winter range along the west slope from approximately Ross Creek to Middle Cottonwood Creek. Studies to provide similar comparative data for other portions of the Bridger complex, and ultimately the entire area, are in progress; and more complete descriptions of vegetal and other environmental characteristics of the area will be reported as results in future progress reports.

METHODS

Population Studies

Mule deer winter distributions and population and range use characteristics were determined primarily through aerial surveys during early and late winter. For the Armstrong range, population data were also obtained through ground observations associated with deer trapping and other studies throughout the winter as well as specific observations of marked and unmarked deer on the area during late winter and early spring.

The intensive helicopter surveys, employing a Bell 47G 3B-2 helicopter with the same pilot and observer as previous years, were completed December 19-22, 1977 and April 2-10, 1978. Coverage during the early winter survey included all mule deer wintering areas in the Bridger complex. The late winter survey included only winter ranges on the west slope, the north one-half of the 16-Mile Creek area, and the Brackett Creek unit. Locations, numbers, sex (in early winter) and age (adult or fawn) were recorded for all observations. In early winter, antler classes of males were also recorded. In addition, elevations and habitat types used, as well as numbers, locations and identifying markings of collared deer were noted. Similar records for all deer observed during fixed wing aerial surveys to relocate "radio"-collared deer at approximately weekly intervals throughout the year provided supplementary population data.

Ground observations to develop late winter population estimates were recorded during a total of 13 days in April. All mule deer observed were recorded as to number, age (adult and fawn), whether marked, specific markings, activity, location, habitat types, elevation, slope gradient and exposure. Groups were recorded collectively, with locations marked precisely on aerial photograph-habitat type maps. Similarly recorded observations on the Armstrong area by Youmans (Pers. Comm.) during early winter provided data for comparative population estimates for that time period.

Additional marked deer in the Armstrong population were obtained by trapping between January 12 and April 24. Trapping methods included a corral type bait trap and cannon net as described by Mackie et al. (1975) plus portable bait traps (Clover 1954). A total of 188 mule deer (71 different animals) was trapped, including 149 recaptures of 27 previously marked animals and 44 new (Table 1). These include four previously marked and two unmarked animals which died in the traps or on the winter range following their release. General markers were four-inch wide collars or neckbands of Armor-tite fabric, color coded using Tuff-flex marking paint, and fastened

with blind rivets. Radio-transmitter collars were fastened to seven new deer, one male and six females (Appendix Table 15), and older or non-functioning transmitters were replaced on four recaptured females. Including these, a total of 13 deer held functional transmitters into June, when 3, including 1 which had worked continuously from early March 1975 (39 months), apparently failed. A summary of mule deer tagged on the area from 1972 through 1978 and their status as of June 1977 is given in Tables 2 and 3.

Table 1. Summary of mule deer trapping effort and success on the Armstrong winter range, winter of 1977-1978 (January 12-April 24, 1978).

Trap No.	No. Trap Nights	No. Deer Caught	No. Deer/100 Nights	No. New Deer Tagged
1[1]	42	54	128.6	7
2[2]	23	7	30.4	6
3	21	10	47.6	1
4	39	25	64.1	6
5	39	26	66.6	3
6	20	6	30.0	5
7	23	10	43.5	2
8	41	19	46.3	1
9	26	13	50.0	2
10	26	12	46.1	2
11	8	2	25.0	2
12	8	3	37.5	2
Totals	316	188	59.5	39[3]

[1]Maher Corral Trap
[2]Trap numbers 2-12 were Clover Traps.
[3]Three additional new deer were marked using the cannon net; and two died in the traps.

Table 2. Summary of mule deer trapped on the Armstrong winter range from 1972 through 1978 and their status as of June 1, 1978.

Year	Total No. Marked	No. Ok[1] 6/78	No. Dead	Unknown[2]
1972	5	1	3 (3)[3]	1
1973	16	3	8	5
1974	39	10	11 (3)	18
1975	36	10	20 (7)	6
1976	10	3	3 (1)	4
1977	16	11	4 (2)	1
1978	42	37	5	0
Totals	164	75	54	35

[1]Number alive and accounted for on Armstrong winter range winter-spring 1978.
[2]Includes at least 4 unreadable-frayed collars on Armstrong winter range in 1978 (See Table 3). Also includes 4 deer that left AWR in past years and wintered elsewhere but were not observed in 1977-78.
[3]Number shot by hunters in parentheses.

Table 3. Years of last observation for currently unknown marked mule deer.

Year Tagged	1972	1973	1974	1975	1976	1977	Total
1972	0	1					1
1973	-	1[1]	1			3	5
1974	-	-	2	6	6[2]	4	18[2]
1975	-	-	-	1	4	1	6
1976	-	-	-	-	1	3	4
1977	-	-	-	-	-	1	1
Totals	0	2	3	7	11[2]	12	35[3]

[1]Last seen summer 1973. One additional animal not previously observed since tagging was believed seen in Truman Gulch in the spring of 1977.
[2]Includes one male marked in 1974 and last seen in 1976, whose collar was found at the head of Reese Creek in October 1976.
[3]Includes at least 4 collared deer on Armstrong winter range in the spring of 1978 with faded, frayed, and otherwise unreadable collars.

A limited amount of trapping, using portable bait traps, was conducted on the Schafer Creek area during March and April to increase numbers of marked deer for population studies and replace or add transmitter collars. Trapping, using cannon nets, was also conducted on the newly established Brackett Creek study area during March and early April to provide marked and radio-collared deer for intensive range use and population studies of mule deer associated with that area (Nyberg 1978). Nine new deer and three previously marked animals were trapped at Schafer Creek and 31 were captured and marked on the Brackett Creek area. Three of the 12 captured on Schafer Creek and 12 of the 31 at Brackett Creek were equipped with transmitter collars.

Following trapping, and as deer left the winter range, radio-collared deer were relocated approximately weekly using receiving equipment from a fixed-wing Piper Supercub aircraft. When or where possible, supplementary relocations were obtained by ground tracking from a vehicle or on foot. As in previous years, an effort was made to visually relocate all transmitter equipped females to determine reproductive success and survival of fawns during the summer.

Mortality records were obtained for the Armstrong area through field and other contacts with hunters and landowners providing access, returns of marked animals and, during winter, by general observations in the course of trapping and other studies on the winter range. As in previous years (Mackie et al. 1976), a systematic "dead deer survey" of the winter range between North Cottonwood and Bill Smith Creeks was conducted in mid-May.

Habitat Studies

As stated earlier, habitat studies were expanded during the spring-summer of 1978 to characterize, in as much detail as possible, the environmental and ecological attributes of the Bridger Mountain complex as they relate to or influence habitat values for mule deer. Distribution and population studies to date have indicated the existence of rather distinct herd units and ranges associated with each of the major winter range areas (Fig. 2); though additional work is needed to confirm their existence and more clearly define "herd range" boundaries. Further, findings and observations indicate gross difference in "habitat" (i.e. environmental and ecological) characteristics between herd ranges (e.g. between the Armstrong herd range and the Brackett Creek herd range) as well as in the sex and age composition and dynamics of the different herd units. Because of this, measurements of environmental and ecological characteristics and parameters will be made on a comparative basis for all herd ranges. These data will be related statistically to population parameters of the individual herd units to evaluate the relative influence or impact of different environmental factors, natural or man-caused, on the density distribution and dynamics of mule deer in the Bridger Range.

The following environmental parameters are being and/or will be obtained from existing maps and records: (1) precipitation; (2) forest timber type

and forest age; (3) age and location of logged areas; (4) land ownership; (5) livestock grazing, past and present; (6) elevations and other topographic characteristics; (7) geology; (8) soils; and (9) locations of human habitation and other areas of intense human activity. These parameters will be mapped on 1:15840 scale and digitized for storage and analysis by automatic data processing equipment. The location and amount of slopes of different steepness and aspect will be derived from existing topographic maps using computer mapping techniques.

Habitat and cover type mapping, which in the past has involved several different approaches and methods in accord with needs and objectives of individual studies, has been standarized for existing and future work as follows: (1) sites representative of "types" are selected on aerial photographs on the basis of their appearance; (2) selected sites are located on the ground; (3) site characteristics are described listing dominant and subdominant species on the basis of occular estimates, listing all other plant species found, and noting elevation, rock type, rockiness of the soil, slope, aspect, crown coverage of trees and any other pertinent information; (4) when a sufficient number of sites has been described, map the cover types on aerial photographs; (5) make further ground checks to determine the reliability of mapped cover types; and (6) digitize the maps for computer storage and later analysis. Habitat types, following the system and classifications of Pfister et al. (1977) and Mueggler and Handl (1974) are also being determined and mapped. From cover type maps, maps and indicies of vegetational interspersion and diversity will be derived.

Existing data on forage availability, production and quality for deer in the Bridger Range are incomplete and limited to the Armstrong range (Buscis 1974, Morton 1976, Pac 1976). Further measures will be obtained with sampling initiated on both winter and summer ranges during the spring of 1978. This analysis involves collections of important species of mule deer forage plants at different sites and in different phenological stages. Chemical analyses will be conducted to determine percentage moisture, protein, fat, and soluble carbohydrates, calculated on the basis of both dry and wet weight of the forage. Plants selected for analysis during 1978 and the elevations at which they were collected are listed in Table 4. Additional plants will be collected in subsequent years. The phenological stages at which samples are collected include: (1) recent emergence of leaf bud; (2) early leaf; (3) full leaf; (4) early flower; (5) full flower; (6) early fruit; (7) mature fruit; (8) post seed drop; and (9) dead or dormant.

Production and availability of all forage species will be measured during several periods through one or more growing seasons, beginning in 1979. Transects will be established in the major summer range habitat types throughout the main Bridger Range and the Battle and Bangtail Ridge areas, with plots clipped from spring until fall. This should also provide some indication of the amount of forage utilized or removed by livestock, since clipping will be done before, during, and after the time these animals are on an area. Year-to-year differences in total production will be monitored by less intensive, annual sampling.

Table 4. Plant species collected for nutritional analyses in the Bridger Mountains during 1978, and the approximate elevations at which samples were obtained.

PLANT SPECIES	APPROXIMATE ELEVATION						
	6000	6200	6800	6880	7200	7680	8200
Thalictrum venulosum		X			X		X
Vaccinium globulare		X	X			X	
V. scoparium						X	
Geranium viscosissimum	X				X		X
Balsamorhiza sagittata	X					X	
Symphoricarpos albus		X		X			
Trifolium haydenii							X

To indirectly estimate forage production between years, an attempt is being made to relate forage production to precipitation and temperature conditions. To this end, precipitation gauges and thermographs are being set up in different places throughout the study area. Some plots will be clipped yearly near the gauges to establish production/precipitation relationships.

Since severity of weather conditions during winter has an effect on the energy budget of deer and subsequently on the dynamics of deer, measurements of weather factors influencing the rate of energy expenditure by the animals will be made on each major winter range for the duration of the study. At each weather station, temperature, wind speed and snow conditions will be recorded. Locations of the seven weather stations established in 1978 are shown in Figure 2. The location of two stations on the Armstrong winter range will provide a measure of conditions in two different habitat types within the winter range.

RESULTS AND DISCUSSION

Distributional Characteristics of Mule Deer in the Bridger Range

Winter

Seven, generally distinct, major winter ranges are used by mule deer in the Bridger Range (Figs. 1 and 2). These include three along the west slope, three on the east side, and the 16-Mile Basin on the north end.

In addition, several less defined local areas appear to be used by small numbers of deer. The largest of these was a 2-3 square-mile area, located along U. S. Highway 89 north of Wilsall, used by about 75 mule deer during the 1977-78 winter.

The size and boundaries of major winter ranges, especially on the east side of the Bridger Range, apparently varies somewhat by year; and those shown in figures 1 and 2 may be representative of years of average or slightly greater snowfall and severity. Constan (1975) indicated a much more restricted winter distribution for east side ranges during winters from 1972-73 through 1974-75. He also reported winter activity along lower Willow Creek, approximately midway between the Livingston and Brackett Creek winter ranges; an area in which we have not observed mule deer since 1975. Also, distributional data from helicopter surveys over most of the east side in January 1975 indicated a somewhat more restricted distribution than those of December-March 1977-78.

Aerial surveys during early and late winter along the west slope since 1971-72 and irregularly in other areas (Table 5) indicate that in most years the upper elevational limit of deer use is about 6,000 ft. after the middle of January. Exceptions occur locally with respect to snowfall and topography and vegetation as they affect snowdepths. In years of "normal" snowfall and temperatures, early winter surveys have indicated deer generally distributed to about 6,800 ft. during late December and early January, whereas in late winter the upper elevation limit is about 6,000 ft. In more moderate, open winters, the general limit seems to be 6,800 ft. with local exceptions to 7,200 ft. Under these conditions, some deer may continue to use essentially summer range or fall "holding areas" (Pac 1976) throughout most or all of the winter. Results of more intensive studies and observations of the distribution of mule deer on the Armstrong winter range have been discussed by Mackie et al. (1976), and will be further reported by Youmans (In Prep.). Comparable data for mule deer use of the Schafer Creek range during 1976-77 and 1977-78 are compiled and reported by Steerey (In Prep.), while Nyberg (1978) will report findings for the Brackett Creek area following the 1978-79 winter.

The total winter range area, excluding the north half of the 16-Mile basin and local areas used by small numbers of deer, comprises about 90,000 acres (140 $mi.^2$) or slightly less than 20 percent of the total area available to deer in the Bridger complex (Fig. 1). The most restricted winter distributions and ranges occur along the west slope of the main Bridger Range. Here, use by mule deer is generally limited to a narrow band of steep south to west facing slopes which rise sharply in elevation from 5,200-5,600 ft. at their lowest margin to 6,800-7,200 ft. The Blacktail Mountain winter range comprises about 2,300 acres (3.6 $mi.^2$); the area from Pass Creek south to Ross Creek, including the Armstrong winter range, about 3,200 acres (5 $mi.^2$); and the area from Ross Creek south to Bridger Canyon, including the Schafer Creek range, approximately 5,800 acres (9 $mi.^2$). The south 16-Mile winter range, which comprises all of the area south of 16-Mile Creek and it's Middle Fork, including Table Mountain, the lower South Fork and the south to westerly slopes of Hatfield Mountain, extends over about 24,000 acres (37.8 $mi.^2$). Elevations range from about 4,600 ft. along 16-Mile Creek to about 6,000 ft.

Table 5. Numbers and sex and age ratios of mule deer classified by aerial (helicopter) survey on various winter ranges in the Bridger Mountain complex during early and late winter, 1971-72 through 1977-78.

		1971-72		1972-73		1973-74		1974-75		1975-76		1976-77		1977-78	
		Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late
NO. END WEST SLOPE	No. Classif.	204	352	523		367	356*	412	600	288	266	236	281	325	315
	♂♂:100 ♀	39.6	–	–		39.8	–	31.1	–	29.9	–	24.7	–	19.7	–
	FF:100 ♀	62.3	–	–		38.3	–	34.8	–	9.2	–	17.0	–	48.7	–
	FF:100 AD	44.6	29.9	32.7		27.4	19.0	26.5	9.4	7.1	6.1	29.6	34.4	40.7	30.3
SO. END WEST SLOPE	No. Classif.	470	332	271		174	162	459	448	335	307	335	365	336	121
	♂♂:100 ♀♀	39.1	–	–		39.6	–	22.8	–	28.6	–	27.2	–	25.0	–
	FF:100 ♀♀	45.4	–	–		32.6	–	51.1	–	25.8	–	46.1	–	53.7	–
	FF:100 AD	32.6	26.7	38.1		23.4	14.8	41.6	31.7	20.0	12.0	36.2	30.8	42.9	31.2
BLACKTAIL MOUNTAIN	No. Classif.	–	–	–		–	–	79	–	174	–	69	133	221	93
	♂♂:100 ♀♀	–	–	–		–	–	48.6	–	33.3	–	24.3	–	19.2	–
	FF:100 ♀♀	–	–	–		–	–	64.8	–	27.7	–	62.1	–	50.7	–
	FF:100 AD	–	–	–		–	–	43.6	–	20.8	–	50.0	37.1	42.5	40.9
SOUTH 16-MILE	No. Classif.	–	–	–		–	–	378	–	290	–	307	–	543	–
	♂♂:100 ♀♀	–	–	–		–	–	6.2	–	16.2	–	5.0	–	7.5	–
	FF:100 ♀♀	–	–	–		–	–	24.5	–	22.4	–	49.2	–	68.2	–
	FF:100 AD	–	–	–		–	–	23.1	–	19.3	–	46.8	–	63.4	–
NORTH 16-MILE	No. Classif.	–	–	–		–	–	665	483+	766	725	814	831	910	1050
	♂♂:100 ♀♀	–	–	–		–	–	6.6	–	15.9	–	8.0	–	9.5	–
	FF:100 ♀♀	–	–	–		–	–	35.4	–	25.6	–	43.3	–	67.8	–
	FF:100 AD	–	–	–		–	–	33.2	32.7	22.1	10.0	40.0	25.9	61.9	39.3
BATTLE RIDGE	No. Classif.	–	–	–		–	–	–	–	148	–	81	–	388	–
	♂♂:100 ♀♀	–	–	–		–	–	–	–	5.3	–	14.5	–	22.8	–
	FF:100 ♀♀	–	–	–		–	–	–	–	25.6	–	54.1	–	78.2	–
	FF:100 AD	–	–	–		–	–	–	–	24.3	–	47.2	–	63.7	–
BRACKETT CREEK	No. Classif.	–	–	–		–	–	299	–	560	–	–	–	978	509
	♂♂:100 ♀♀	–	–	–		–	–	11.3	–	5.0	–	–	–	12.2	–
	FF:100 ♀♀	–	–	–		–	–	49.4	–	32.5	–	–	–	74.1	–
	FF:100 AD	–	–	–		–	–	44.4	–	31.0	–	–	–	66.0	51.2
LIVINGSTON-BILLMAN CR.	No. Classif.	–	–	–		–	–	300	–	223	–	–	–	266	–
	♂♂:100 ♀♀	–	–	–		–	–	12.8	–	10.7	–	–	–	18.9	–
	FF:100 ♀♀	–	–	–		–	–	41.0	–	26.1	–	–	–	67.1	–
	FF:100 AD	–	–	–		–	–	36.3	–	23.6	–	–	–	56.4	–
OTHER MISCELLANOUS AREAS	No. Classif.	–	–	–		–	–	–	–	–	–	–	–	28	–
	♂♂:100 ♀♀	–	–	–		–	–	–	–	–	–	–	–	7.1	–
	FF:100 ♀♀	–	–	–		–	–	–	–	–	–	–	–	92.9	–
	FF:100 AD	–	–	–		–	–	–	–	–	–	–	–	86.6	
BRIDGER RANGE TOTALS	No. Classif.	674	684	794		541	518	2592	1531	2784	1298	1842	1610	4060	2088
	♂♂:100 ♀♀	39.3	–	–		39.7	–	14.8	–	16.5	–	13.5	–	14.6	–
	FF:100 ♀♀	50.3	–	–		36.4	–	38.7	–	25.1	–	45.0	–	66.4	–
	FF:100 AD	36.1	28.3	34.4		26.1	18.5	33.7	22.3	21.5	9.7	39.6	29.3	58.0	39.9

*Not including 100+ unclassified
+Northwest of 16-Mile Creek only

The terrain is generally of the "Breaks" type of slight to moderate gradient. Together with the North 16-Mile unit, which may be used predominantly by resident deer and deer migrating from the Big Belt Mountains to the north, the 16-Mile Basin comprises the single largest winter range associated with the Bridger complex. Winter ranges along the east side are broad and extensively encompass gently sloping, open ridge and bench lands which extend from the lower slopes of Battle and Bangtail Ridges to the Shields and/or Yellowstone Rivers. Elevations range from 4,800-5,200 ft. at the lower limits of mule deer distribution to 6,000-6,200 at the upper limit for most years. The Battle Ridge winter range includes about 17,500 acres (27.5 $mi.^2$), the east-central portion of which, between Antelope and Fox Creeks, receives only light usage by mule deer. Aside from the 16-Mile Basin, the Brackett Creek winter range appears to be the single largest mule deer wintering area in the Bridger complex. It encompasses about 25,000 acres 38.5 $mi.^2$), including all of the Brackett Creek drainage below Miles Creek, all but the timbered upper reaches of Canyon Creek, and Bangtail Creek. The Livingston area includes about 18,500 acres (28.9 $mi.^2$) extending from the north rim of Ferry Creek south and west to Billman Creek and Flynn Creek.

The major winter ranges differ broadly in vegetal, climatic and land use characteristics as well as in their topo-physiographic attributes. To date, quantitative descriptions have been developed only for the Armstrong winter range (Bucsis 1974) and the Schafer Creek winter range (Steerey 1977, In Prep.). Studies in progress (Jorgensen 1977, Nyberg 1978, This Report) will extend descriptions to remaining portions of west slope ranges as well as to the other areas; with results to be presented in subsequent reports. In general, the east side ranges are characterized by relatively open vegetation consisting of sagebrush-grassland with scattered clumps or individual plants of Rocky Mountain juniper (*Juniperus scopulorum*). Agricultural croplands are interspersed, especially at lower limits, while timber cover occurs mainly along a few drainages and at the upper margins. The 16-Mile basin area is characterized by extensive stands of shrubby and shrub-grass vegetation interspersed by open to moderately dense stands of Douglas fir (*Pseudotsuga menziesii*), limber pine (*Pinus flexilis*) and Rocky Mountain juniper along slopes of all drainageways. West slope ranges are generally characterized by steep open slopes dominated by grass-forb or grass-shrub vegetation. Moderate to dense stands of timber, primarily Douglas fir, are interspersed; extending upward along north slopes of canyons and draws from the lower limits of the winter range. Open stands of timber and Rocky Mountain juniper usually extend onto south and westerly exposures at higher elevations. Major differences between west slope ranges appear to be in the relative representation of various habitat and cover types and in the occurrence of some individual plant species of importance to deer. For example, antelope bitterbrush (*Purshia tridentata*) is well represented in shrub-grass vegetation on the Armstrong range but absent on the Schafer Creek area (Steerey 1977).

Summer

Substantial data on the spring-summer-fall distributions, movements, and habitat usage of deer in the Bridger Range have been obtained only for animals associated with the Armstrong and Schafer Creek winter ranges. Findings concerning the Armstrong population have been discussed by Schwarzkoph

(1973), Hamlin (1974), Pac (1976), Mackie et al. (1976) and Mackie and Knowles (1977). Data for the Schafer Creek population will be presented separately by Steerey (In Prep.), while current studies of deer associated with the Brackett Creek winter range are in progress (Nyberg 1978) and will be presented in future reports.

Cummulatively, findings indicate that essentially all of the Bridger Range complex is or may be used by mule deer during spring, summer and/or fall. This includes agricultural crop and range lands west to Dry Creek and east possibly to the Shields and Yellowstone River bottomlands. In this sense "summer range" may be viewed as including all of the approximately 800 square miles included in the study area. However, with some exceptions, notably in the 16-Mile Basin, most summer-fall activity and use by mule deer occurs within the Bridger Range at elevations above about 5,600 ft. (Fig. 3). This includes a land area of nearly 278,000 acres (434 $mi.^2$) or about 60 percent of the total. Because this area includes that on which the majority of winter use also occurs, except in 16-Mile Creek, it might also be viewed as the primary yearlong range of mule deer in the Bridger complex. Lands above 6,000 ft. (Fig. 3), encompassing some 182,000 acres (284 $mi.^2$), essentially include only late spring, summer and fall-early winter range.

Although data for recent years indicate only very minor summer use of rangelands at elevations of less than 5,600 ft., this may not always have been the case. Wilkins (1957) presented data which indicated (Mackie et al. 1976) that a substantial proportion of the Armstrong population was "resident" to agricultural crop and rangelands adjacent to the Armstrong winter range during the early to mid 1950's. Today, the 16-Mile Creek area apparently continues to have a substantial resident population utilizing the entire area to the lower limits of winter range; and mule deer apparently resident to winter range have been recorded among radio-collared and neckbanded animals on the Armstrong (Fig. 4), Schafer Creek (Steerey In Prep.) and Brackett Creek (Nyberg 1978) winter ranges.

Spring dispersal and summer distribution, movements and home ranges of radio-collared deer associated with the Armstrong winter range were discussed by Mackie and Knowles (1977). During 1977-78, distributions and movements of previously marked animals as well as of animals newly collared in the winter of 1978 (Fig. 4) were generally similar and supported previous conclusions. Two of the newly collared deer moved off the winter range to summer at moderate elevation in Bill Smith Creek, one moved to the South Fork of Tom Reese Creek, the most southerly location during summer of any deer radio-collared on the Armstrong Range, and four ultimately moved to the Frazier Creek drainage on the east slope of the main Bridger Range. The latter five deer were all tagged on and/or used the southern boundary of the Armstrong winter range during winter and spring.

Radio-collared and neckbanded mule deer from the Armstrong winter range have consistently distributed themselves during the summer in an area bounded on the north by Pass Creek and Flathead Creek, on the east by State Highway 293, on the south by North Fork of Brackett Creek and Tom Reese Creek. Most summer in drainages immediately above and adjacent to the winter range; though as many as one-third may move to drainages further north or along the east slope of the main Bridger Range (Pac 1976). These data, together with similar

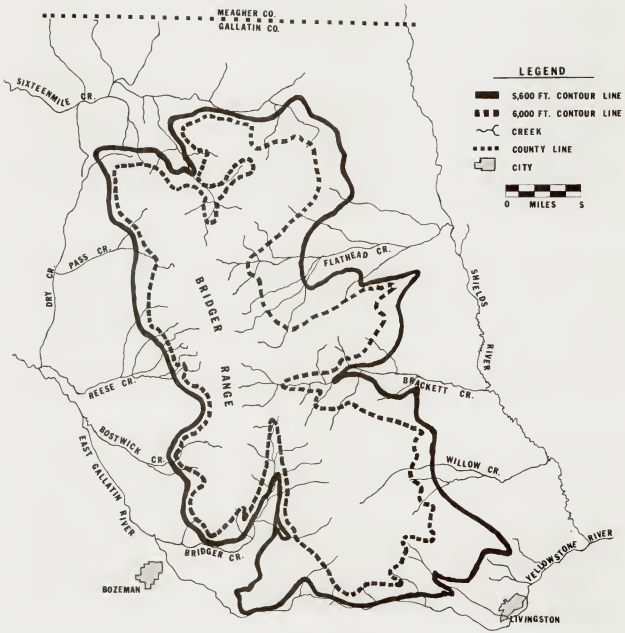

Figure 3. Map of Bridger Range showing 5,600 ft. and 6,000 ft. contour lines. The 5,600 ft. line representing approximately the lower limits of yearlong mule deer range and the 6,000 ft. contour delimiting that portion of the Range used primarily during spring, summer and fall.

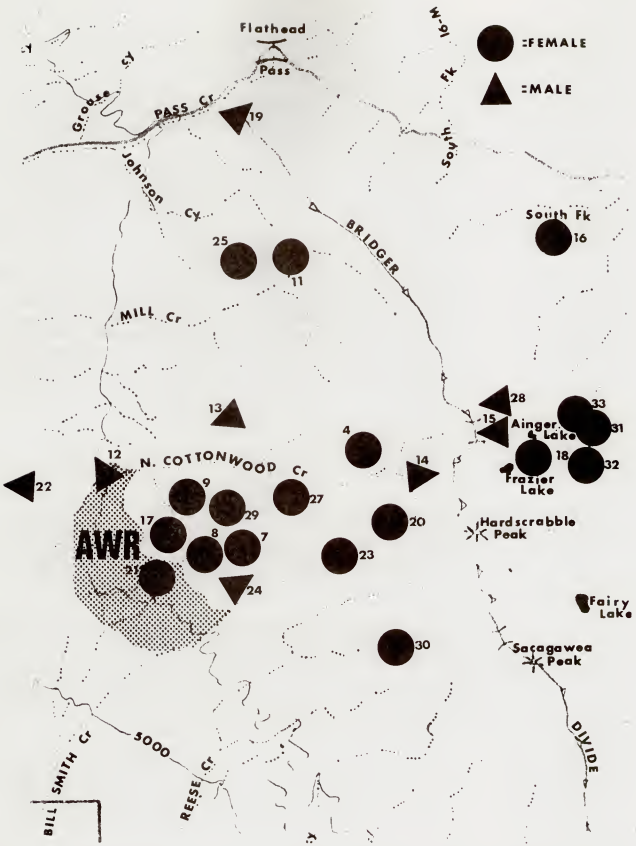

Figure 4. Generalized centers of summer activity of 26 mule deer (18 adult females and 8 adult males) radio-collared on the Armstrong winter range during 1975, 1976, 1977 and 1978. Numbers indicate individual animals listed in Appendix Table 15. See text for further explanation of movement patterns.

findings for deer marked on the Schafer Creek (Steerey In Prep.) and Brackett Creek (Nyberg 1978) areas, suggest that deer associated with the various winter ranges may comprise population units which occupy fairly distinct and definable herd ranges. Also, deer using sub-units or particular portions of winter ranges may be associated with particular portions of the summer herd range. These observations are consistent with previous findings that the distribution and movements of mule deer off the Armstrong range reflect individual learned behavioral patterns which apparently become traditional. However, because of the latter, there are exceptions to the general movement and distributional patterns; and some overlap appears to occur between herd ranges of deer associated with the various winter ranges. Data are not yet sufficient to indicate either the extent or the significance of this.

Distributions and movements of marked females have been especially consistent, with respect to locations of seasonal home ranges, movements within "home ranges", and the timing of movements, relative to one another (Mackie and Knowles 1977). We have no positive record of any marked female of any age dispersing from the Armstrong "herd range" or changing a seasonal home range between years. Marked males have been less consistent in movements and range use patterns between years. Several young males are known to have dispersed to other "population units"; and a few older adults have been found to change either their summer or winter "home range" between years.

Population Characteristics of Mule Deer in the Bridger Range

Trend and Dynamics of the Armstrong Deer Herd

The 1977-1978 Winter

Monthly weather data and severity indices (Picton and Knight 1969) for the Montana State University Weather Station at Bozeman (Table 6) compare November-May conditions from 1971-72 through 1977-78. Although located 15 air miles south of the Armstrong winter range, this station is only slightly lower in elevation and conditions are considered reasonably representative of general conditions along the west slope of the Bridger Mountains.

These data indicated that the 1977-78 winter was more severe than the previous two winters, but less severe than those from 1972-73 through 1974-75, and was characterized generally by near average temperatures and average snowfall. However, little melting occurred such that a snow cover was persistent from December through March and accumulation was greater than normal to late March. Thereafter, melting occurred rapidly and conditions remained mild throughout the spring period.

Phenological data, based on lilac bloom dates for the Bozeman area (D. K. Scharff, pers. comm.) are listed in Table 7. These data indicate that plant growth and development during 1978 may have been the earliest in more than 20 years; while 1977 was the second earliest. During 1975, snow melt and plant phenology were approximately two weeks later than normal (Pac 1976) and the latest in more than 20 years (Table 7).

Table 6 . Climatological data, MSU Weather Station, Bozeman, and severity indices, November through May, 1971-1978.

		Ave. Temp. (°F)	Ppt. (in.)	Total Snowfall (in.)	Max. Snow Depth (in.)	No. Days Snow on Ground	Severity[1] Index
November	1971	33.7	0.77	11.2	5	17	- 297
	1972	32.8	0.63	3.0	4	8	- 250
	1973	30.4	1.27	15.8	11	25	+ 104
	1974	35.1	0.67	4.7	2	10	- 377
	1975	30.5	1.33	20.5	12	15	+ 491
	1976	35.5	.20	3.9	4	4	- 415
	1977	31.7	1.19	12.0	8	11	+ 260
December	1971	20.8	0.56	11.1	10	31	+ 1161
	1972	18.6	0.49	12.2	4	23	+ 1047
	1973	29.5	1.29	20.5	13	16	+ 234
	1974	25.5	1.02	13.2	6	31	+ 284
	1975	30.0	1.10	15.8	6	22	+ 84
	1976	30.3	.22	3.3	3	8	- 232
	1977	25.2	1.19	12.7	8	22	+ 315
January	1972	19.1	0.86	13.8	10	31	+ 1068
	1973	19.2	1.10	16.6	9	31	+ 1837
	1974	21.3	0.42	5.8	14	25	+ 3743
	1975	22.8	1.58	22.9	14	31	+ 1369
	1976	26.6	0.60	8.7	9	28	+ 360
	1977	30.3	.60	13.5	9	31	+ 583
	1978	22.2	1.03	13.7	12	31	+ 842
February	1972	31.0	0.66	10.2	6	27	- 75
	1973	24.4	0.04	1.8	8	28	+ 483
	1974	32.0	0.43	7.8	4	21	- 206
	1975	21.3	1.11	19.5	17	28	+ 1659
	1976	30.4	0.52	9.8	4	5	- 187

Table 6 (Continued).

		Ave. Temp. (°F)	Ppt. (in.)	Total Snowfall (in.)	Max. Snow Depth (in.)	No. Days Snow on Ground	Severity[1] Index
	1977	33.8	.06	1.0	3	17	- 322
	1978	26.3	.87	15.1	11	28	+ 892
March	1972	41.0	1.24	13.6	8	8	- 586
	1973	33.9	1.89	23.0	11	31	- 303
	1974	32.6	1.71	24.7	7	26	- 206
	1975	29.1	1.08	20.7	9	31	+ 295
	1976	28.7	1.03	18.5	6	12	+ 262
	1977	30.9	2.39	27.0	8	23	- 184
	1978	37.2	.74	4.6	10	19	+ 59
April	1972	41.3	1.91	21.9	4	5	- 652
	1973	38.9	2.84	34.7	14	14	- 520
	1974	45.8	1.87	3.2	0	0	- 764
	1975	32.9	1.77	16.1	8	24	- 141
	1976	43.4	3.35	21.9	4	4	- 663
	1977	48.1	.57	5.7	8	4	- 875
	1978	44.9	.93	1.4	trace	0	- 692
May	1972	50.7	1.73	trace	1	0	- 958
	1973	51.4	1.44	1.3	trace	0	- 989
	1974	48.3	3.00	12.1	3	3	- 880
	1975	46.9	4.88	21.5	9	6	- 803
	1976	55.5	1.95	trace	0	0	- 1157
	1977	50.3	3.84	3.4	0	1	- 946
	1978	49.7	4.04	1.0	0	0	- 886

Table 6 (Continued).

		Ave. Temp. (°F)	Ppt. (in.)	Total Snowfall (in.)	Max. Snow Depth (in.)	No. Days Snow on Ground	Severity Index
Nov. -							
May	1971-72	33.9	7.7	81.8	10	119	- 329
	1972-73	31.3	8.4	92.6	14	135	+ 1335
	1973-74	34.3	10.0	89.9	14	116	+ 2025
	1974-75	30.5	12.1	118.6	17	161	+ 2286
	1975-76	35.2	9.9	95.2	12	86	- 810
	1976-77	37.4	7.9	57.8	9	88	- 2391
	1977-78	33.9	10.0	60.5	12	111	+ 790
20 Year Ave.		32.4	9.5				

[1] + Values indicate greater severity.

Table 7. Phenology of lilac development and growth in Bozeman. Data provided by Donald K. Scharff, Professor, Biology Dept., Montana State University, Ret.

Year	Early Bud Stage[1]	Lush Full Bloom[2]	Remarks
$\bar{X}$ 1955-1970	12 May	8 June	
1971	11 May	10 June	
1972	3 May	31 May	
1973	16 May	11 June	
1974	3 May	13 June	
1975	18 May	24 June	Latest recorded for both
1976	-	2 June	
1977	25 April	28 May	2nd earliest recorded for both
1978	20 April	28 May	Earliest recorded for both

[1]Early bud stage = first sight of flower buds, leaf buds will be open and new growth will be about 1" long.
[2]Peak of bloom.

Population estimates for mule deer using the Armstrong winter range during 1977-78 (Tables 8 and 9) were developed as Lincoln (Overton and Davis 1969) and Schnabel indicies for observations of marked and unmarked animals during early and late winter.

Cumulative ground, aerial and trapping records provided knowledge of the numbers of marked deer on the area throughout the winter. At the end of April, approximately 75 animals wearing recognizable collars were on the winter range; and approximately 4 additional animals wore unrecognizable, frayed or faded collars (Table 2). It is possible that even more animals with unreadable collars occurred (Table 3); however, this would seem unlikely since most of the remaining 30 deer which could have been present have not been seen on the Armstrong range since the spring of 1976 or earlier. Also, observations indicated that 45-50 percent of all deer on the winter range were collared. The mean percentage of collared deer in all observations during April was 45.2 percent, with a range of from 14.2 to 62.1 percent among individual observations. The mean for the eight best observation periods, when 40 or more deer were recorded, was 49.5 (38.8-62.7) percent. Between 25 and 40 percent of all deer on the Armstrong range were marked at various times during the previous four winters.

For late winter 1978, a population of 160 animals is believed to represent the best estimate of mule deer numbers on the Armstrong winter range. The

Table 8. Early winter estimates of numbers of mule deer on the Armstrong winter range, December-March 1978.

Estimated Numbers Total	S.D.[1]	Remarks
195	47.15	$\bar{X}$ Lincoln index for 25 best ground observations (>40 deer obs/survey) and only readable collars (39-80).
202	45.95	$\bar{X}$ Lincoln index for 25 best ground surveys and all collared deer (49-84).
196		Schnabel index for 25 best ground surveys and readable collars (39-80).
201		Schnabel index for 25 best ground surveys and all collared deer (49-84).

[1]Standard deviation.

Table 9. Late winter estimates of numbers of mule deer on the Armstrong winter range, April 1978.

Estimated Numbers Total	S.D.[1]	Remarks
155	30.30	$\bar{X}$ Lincoln index for 8 best ground surveys (>40 deer obs/survey) and only readable collars (73-76).
161	32.53	$\bar{X}$ Lincoln index for 8 best ground surveys (>40 deer obs/survey) and all collared deer (77-80).
152		Schnabel index for 8 best ground surveys and readable collars (73-76).
158		Schnabel index for 8 best ground surveys and all collared deer (77-80).
157		Schnabel index for all 13 ground surveys during April and readable collars only (73-76).
162		Schnabel index for all 13 ground surveys during April and all collared deer (77-80).

[1]Standard deviation.

mean Lincoln index for the eight best observation periods in April, using only observations of readable collars, was 155 mule deer (Table 9). The mean, using observations of all collared deer, on a base of 77 to 80 collared animals in the population at the time observations were made, was 161 deer. Schnabel indicies, based on readable collars, were similar at 152 deer and 157 deer for the best eight days and for all observations during April, respectively. These data, using all collared deer observations, indicated 162 deer present. A point estimate of 160 mule deer is also obtained assuming a total collared deer population of 80 animals to represent 50 percent of all deer using the area.

Estimates of mule deer numbers on the Armstrong range during early winter generally are more difficult to obtain than those for late winter when the population is much more concentrated, using open habitat types, and includes maximum numbers of marked deer. In our judgement the 200 deer estimated to be present from observations during December-March (Table 8) may be low by at least 20-25 animals as a result of sampling problems and/or the use of areas outside of the winter range boundaries by some deer. On the basis of 1977 spring population estimates and fawn:doe ratios observed in early winter, a fall (pre-hunting season) population numbering about 260 deer was expected. This would have included about 145 adult females, 30 adult males, 25 yearling males and at least 60 fawns. In contrast, the early winter estimated population of 200, based on sex and age ratios observed in December, included about 126 females, 9 adult males, 7 yearling males, and 58 fawns. A slight loss of adult females was indicated by mortality records for the fall period, while losses of fawns, if any were not detected. However, substantial losses of males occurred. Within the immediate vicinity of the winter range, 13 males, including 2 yearlings, were known to have been killed by hunters. This represented only a small portion of the area used by Armstrong deer during the hunting season, and total losses of males may have been much higher. Tag returns, which may be minimal, showed that 15 of 29 (52 percent) marked bucks available to hunters along the west slope in the fall of 1977 were killed, including 8 of 15 from the Armstrong population. Thus, hunter mortality, together with other known mortality of males prior to or during early winter, could account for essentially all of the males lost; but not for most of the females and at least some fawns. During the severe 1974-75 winter 20-25 deer, primarily females, apparently wintered off the Armstrong Range only to return the following winter (Mackie and Knowles 1977). Because of this, we believe that a population of approximately 220 animals including about 143 adult females, 17 males and 60 fawns would be a more reasonable estimate of numbers on or associated with the area in early winter 1977-78 than that provided by data of Table 8.

The estimated 160 mule deer on the Armstrong range in late winter and early spring included approximately 116 adult females, 12 adult males, and 32 fawns (Table 10). These data, compared with estimates for early winter, indicated moderately heavy overwinter mortality. Between 40 and 60 animals died, or 20-27 percent of early winter numbers. Known deaths included 25 deer found dead during the winter or during a systematic search for carcasses in May (Table 11) and 6 trap-related casualties. Mortality was comparatively severe among fawns, the total apparently representing 45-47 percent of early winter numbers. Adult losses totaled 10-20 percent and consisted primarily

Table 10. Estimated late winter-spring mule deer populations on the Armstrong winter range, 1973-1978.

Year	Total Number	No. Ad. Females	No. Males		No. Fawns
			Adult	Yrlg.	
1973	230	123	31	27	49
1974[1]	220	130	27	23	40
1975	140	92	35	8	5
1976	170	118	37	3	12
1977	200	120	24	6	50
1978	160	116	6	6	32

[1]No population estimate calculated. A spring population slightly lower than that of 1973 is assumed as consistent with fawn production and survival for 1973 and 1974 and an early winter estimate of 210 mule deer on the range in January 1975 (Mackie et al. 1976).

Table 11. Number and age classes of winter-killed mule deer found on the Armstrong winter range, 1971-1977.

Year	Number					
	Total	Fawns	Yearling	Prime	Old	Unknown
1971-1972	19	9	-	-	10	-
1972-1973	18	12	-	1	5	-
1973-1974	12	10	-	-	2	-
1974-1975	42	16	2	10	14	-
1975-1976	2	2	-	-	-	-
1976-1977	2	-	-	1	1	-
1977-1978	25	11	-	-	7	7
Total	120	60(50.0%)	2(1.7%)	12(10.0%)	39(32.5%)	7(6.0%)

of old-aged animals (Table 11). Much of the mortality, especially among fawns appeared to occur in late March, just before and during the period of snowmelt. During 1975, a year of even more severe mortality among deer on the Armstrong range, most fawn losses occurred earlier in the winter; "old" animals were lost in late March and April, and "prime" deer in April and May (Mackie et al. 1976). Loss of prime adult deer was not recorded in 1978, except among trap-related deaths. Rather heavy mortality of fawns was also indicated by the change in the proportion of fawns among deer classified in aerial surveys in the vicinity of the Armstrong range during early and late winter (Table 12).

Trends in estimated mule deer numbers and the sex and age compositon of late winter-spring populations on the Armstrong range from 1973 through 1978 are shown in Table 10. Derivation of these data for previous years was discussed by Mackie et al. (1976), Mackie and Stewart (1976) and Mackie and Knowles (1977). Approximate trends in early winter populations, derived indirectly on the basis of all information available (Mackie and Knowles 1977, This Report), are shown in Figure 5.

These data indicate that the population in 1973-74 was generally similar to that of 1972-73, both in early and late winter. At least 250 deer were believed present in early winter 1972-73 and 240-250 in 1973-74. Late winter populations numbered about 230 in 1973 and 220-230 in 1974. Overwinter mortality was light, an estimated 8-10 percent each year; and, if fewer deer occurred in 1974, this was due largely to the presence of fewer fawns that year as indicated by ground (Schwarzkoph 1973) and aerial (Table 12) classifications. These indicated about 36 fawns:100 adults in early winter of 1972-73 and 31:100 for 1973-74. Late winter ratios were approximately 27:100 and 22:100, respectively.

Fawn production, or survival to early winter, declined even further in 1974-75; and fewer total deer appeared on the area. The January population estimate of 210 deer (Mackie et al. 1976) did not include 20-25 adult females which apparently spent much, if not all, of the winter off the study area (Mackie and Knowles 1977). Overwinter mortality in 1974-75 increased sharply to 30-35 percent of the January population. Included were 85-90 percent of the fawns and about 22 percent of the adults (Mackie et al. 1976). The 140 mule deer remaining in early June were 35-40 percent fewer than occurred on the area in late winter and early spring in either 1973 or 1974.

Fawn production and survival was extremely low during summer-fall of 1975 and an early winter population of 170-180 deer was indicated. This included about 7 fawns:100 adults (12-15 total fawns) and 20-25 more adult females than were present in the spring of 1975 (Mackie and Stewart 1976). Very few yearlings also occurred. Overwinter mortality, however, was slight; and an estimated 170 deer remained in late winter and spring 1976. This was approximately 20 percent more than occurred in June 1975.

Table 12. Aerial classifications of mule deer on the Armstrong Winter Range, January 1972 through April 1978[1].

		NUMBERS							RATIOS			PERCENTAGES		
		Total Count	Total Class.	Adults	Males	Females	Fawn	Uncl.	F:100 Females	F:100 A	Males:100 Females	% Fawn	% Ylg Males	% Spike Ylg Male
Reese Cr. -	1971-72 Jan. 3	173	173	119	39	80	54	-	68	45	49	31	56	26
N. Cttnwd.	Mar. 28	92	83	68	-	-	15	9	-	22	-	18	-	-
	1972-73 Feb. 7	188	188	143	-	-	55	-	-	31	-	24	-	-
	1973-74 Dec. 27	131	131	100	28	72	31	-	43	31	39	24	46	62
	Apr. 1	188	188	154	-	-	34	-	-	22	-	18	-	-
	1974-75 Jan. 5	140	140	116	37	79	24	-	30	21	47	17	19	17
	Mar. 23	227	227	214	-	-	13	-	-	6	-	6	-	-
	Apr. 20	99	99	96	-	-	3	-	-	3	-	3	-	-
	1975-76 Jan. 2	121	121	113	29	84	8	-	10	7	35	7	7	100
	Mar. 15	102	102	90	-	-	12	-	-	13	-	12	-	-
	1976-77 Jan. 5-9	90	90	70	14	56	20	-	36	29	25	22	21	100
	Mar. 10-11	116	116	87	-	-	29	-	-	33	-	25	-	-
	1977-78 Dec. 19	133	133	94	11	83	39	-	47	42	13	29	46	40
	Apr. 2	126	126	101	-	-	25	-	-	25	-	20	-	-

[1]Includes some animals ranging between Bill Smith and Reese Creeks not included in the Armstrong Winter Range population.

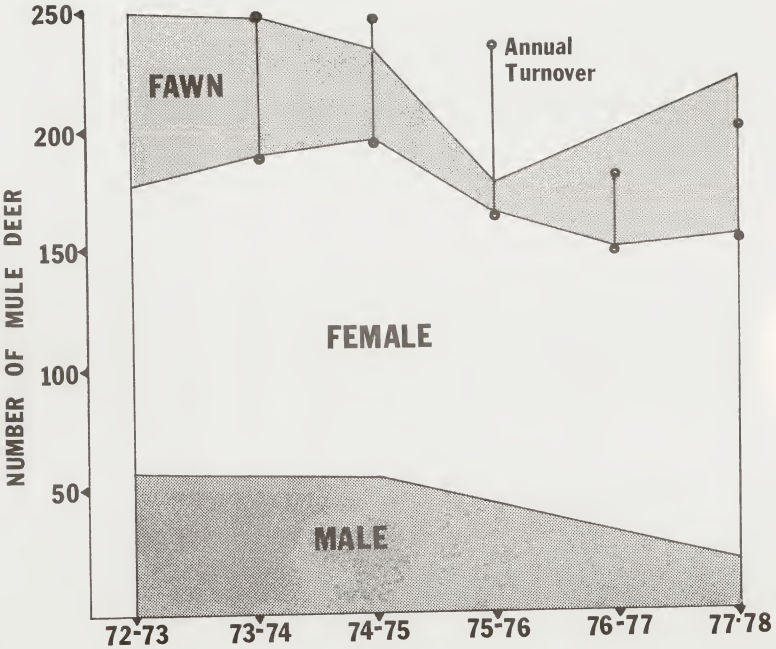

Figure 5. Population trend of mule deer on the Armstrong winter range, Bridger Mountains, 1972-78.

Population data and calculations for 1976-77 indicated approximately 200 mule deer on the Armstrong area throughout the winter. Mortality was again slight. The 30 additional deer in spring represented an increase of about 18 percent over numbers present in the spring of 1976. Most of this was attributed to relatively high fawn survival to and through the 1976-77 winter (Tables 11 and 12); though hunting and overwinter mortality of adults, especially adult females, was also exceptionally low.

Data for 1977-78, which showed at least 200, and more likely 220, mule deer indicated that the population increase, which began in 1976-77, continued through early winter 1977-78. Fawn production and/or survival to early winter was the highest recorded on the area since the study began in 1971. The substantial overwinter mortality, however, reduced the late winter-spring population to about 160 deer or some 20 percent fewer than occurred in the spring of 1977.

Hunting may have been important in the 1977-78 trend. Table 13 lists the known hunting mortality of mule deer marked on the area from 1972 through 1977. Of 122 marked through the spring of 1977, 16 (13.1 percent) were known to have been shot. At the same time, 19.7 percent of the total died as a result of other mortality factors (18.1 percent natural and 1.6 percent trap-related). Previously, except for 1972 when only a few marked deer occurred, percentages of marked deer shot annually were very low. As indicated earlier, however, at least 53 percent of the available marked bucks from the Armstrong range and 52 percent of those available from the Armstrong and Schafer Creek areas combined were killed in the fall of 1977.

Table 13. Known hunting mortality of mule deer marked on the Armstrong winter range, 1972-1977.

Year Marked	Number Marked	Year Killed						
		1972	1973	1974	1975	1976	1977	Total
1972	5	1 (1½M)	1 (2½M)	0	0	1 (5½M)	0	3
1973	16	-	0	1 (7½M)	0	0	0	1
1974	39	-	-	1 (1½M)	0	0	2 (4½M) (10-12M)	3
1975	36	-	-	-	2 (4½M) (6½F)	1 (3½M)	4 (5½M) (7½M) (4½M) (7½M)	7
1976	10	-	-	-	-	0	0	0
1977	16	-	-	-	-	-	2 (2½M) (8½M)	2
Totals	126	1	1	2	2	2	8	16
No. Mkd. in Pop.[1]		5	20	56/58	67/69	64/78	66/87	
% Shot		20.0	5.0	3.5	3.0	2.8	10.4	

[1]1974-1977 - Known No. Marked/Total Possible Marked Present.

The heavy harvest of bucks during the 1977 hunting season probably reflected deep snow accumulations and/or other factors which caused deer to concentrate at low elevations during the last two weeks of the season, relatively high hunting pressure, and the relatively large number of adult males in the population. As in 1976, hunting was for males only except for 100 either-sex permits issued for Hunting District 312 which includes the Bridger Range. Had either-sex hunting prevailed generally, as in years prior to 1975, it seems likely that a relatively heavy harvest of females would also have occurred.

The proportion of adult (yearling and older) males in the Armstrong population has declined progressively since early winter 1974-75; while the female segment of the population has remained relatively stable (Fig. 5, Table 10). This trend seems to have been influenced greatly by low recruitment of yearlings since the spring of 1975 (Table 10), mortality of "old" adults overwinter in 1974-75 and again in 1977-78, and hunting losses of "prime-aged" adults throughout and, especially, in 1977. The effects of hunting on relative trend can only be analyzed and interpreted with an understanding of other factors governing and influencing the dynamics of mule deer on the area.

Table 14 lists the distribution by age class of mule deer trapped on the Armstrong range each year since 1972. Ages were assigned categorically to the nearest year when possible or to a class on the basis of tooth replacement and wear (Robinette et al. 1957). These data indicate that very few males older than 7½-years of age occur. Only 5 of 99 males handled were recorded as "old" (8-10 years), while 23 of 159 females were estimated to be "old" and 6 were recorded as "very old" (older than 10 years). This apparently occurs despite the fact that the Bridger Range, especially the west slope, represents relatively high security habitat for mule deer. That large numbers of animals may occur in the "old prime" (6-7 years) category among males and in the "old" (8-10 years) class for females, at least in some years, while few occur in older age classes, would seem to indicate that 7-8 years is the maximum expected longevity of males and 10-12 years is the maximum for females on the Armstrong area. Some older animals may persist, especially during periods of favorable environmental conditions, but these are relatively few in number and usually will be lost rapidly with onset of an adverse condition. These relationships have been illustrated also by mortality/survival patterns among marked deer (mortality records for marked males and females are summarized in Appendix Tables 17 and 18, respectively).

Mortality data for marked males indicate relatively high mortality among fawns, light to moderate mortality of young to prime adults (1-6 years of age), primarily due to hunting, and high mortality among animals 7-years of age and older. Only one buck believed to be older than 7½ years has been marked, and this animal died the same winter. Only two marked when 7½-years of age or younger have survived beyond 8½, including one 7½-year old which survived the 1977-78 winter. A second, believed to be about 8½ years, was seen on the Armstrong range during the fall of 1977, but not during winter; and its current status is unknown. Three marked bucks, 7½ or older died as winterkills or trap-related winter losses, in very poor physical condition, during the 1977-78 winter.

Table 14. Mule deer population age structure on the Armstrong winter range as determined from deer trapping samples, 1972-1978.

Year	Sex	Total No. of deer	Numbers of deer by age category						
			½	1	2-5	6-7	8-10	10+	Uncl. Ad.
1972	M	4	4						
	F	1			1				
1973	M	6	1	1	4				
	F	12		1	9		2		
1974	M	12	4	2	3	1			2
	F	36	1	5	21	2	4	2	1
1975	M	21	2	2	15		2		
	F	29	2		17	4	3	3	
1976	M	15			10	2	1		2
	F	8		1	4	2	1		
1977	M	13		1	4	7	1		
	F	20	1		12	5	2		
1978	M	18	10	4	2	1	1		
	F	53	6	4	17	14	11	1	

Similar data for females have indicated only very light mortality has occurred among animals less than about 10 years of age, including fawns trapped during their first winter; and relatively large numbers of does aged as 8½, 9½, and 10+ years have been trapped. All females believed to be older than 10 years died during 1977-78; but the spring 1978 population (116 adult females, 55-60 marked) included at least 22 and possibly 24 marked does believed to be at least 8 years old and an additional 10 that were at least 7 years.

In summary then, the maximum life expectancy of male mule deer on the Armstrong range appears to be only about two-thirds as long as that of females (7-8 years vs 10-12 years); and mortality rates and patterns also differ. Among males, mortality appears to be relatively high among very young, light to moderate and largely due to hunting from 1 through 7 years of age, and heavy to all causes after 7-8 years. In the case of females, mortality seems to be light and relatively constant from about 6-9 months through about 10 years, when it increases sharply. It might also be notable that the effects of severe winters on mortality have been to eliminate very "old" animals (i.e. males older than about 7 and females older than about 10) of both sexes; while among younger animals these effects were directed to the youngest (fawn through 2-year olds) males and all age classes of females. Our data are as yet too meager to evaluate the implication that heavy early and hunting mortality in males may substitute for natural mortality through the "prime" age classes.

The foregoing mortality patterns are both expressed in and supported by population trends and dynamics of deer on the Armstrong range. Calculations similar to those made by Mackie (1976) for the Missouri Breaks mule deer population, comparing numbers of males, females and fawns in successive early winter populations (Fig. 5), indicate that the average annual mortality or "turnover" rate among males on the Armstrong area is about 44 percent (33-69 percent annually) and for females about 12 percent (ranging from less than 1 to 23 percent annually). The population mean has been about 21 percent (17-29 percent annually). The highest annual rate for males, 69 percent, occurred during 1977-1978 and was probably due to the heavy hunter harvest of bucks during the fall of 1977. In previous years the rate for males averaged about 37 percent and ranged from 33 percent to 43 percent. Total annual mortality, excluding that of fawns less than 6-months old, is 2-3 times greater among males than females. The average difference between males and females here is somewhat greater than in the Missouri River Breaks where the mean "turnover" of males has been about 47 percent during the past 19 years and the mean for females was about 23 percent (Mackie 1976, Hamlin 1978). The population mean, about 21 percent, for the Armstrong population, is about one-third lower than the mean of about 30 percent for the Breaks population.

Relating the above mortality or "turnover" rates to population trends during the past 6 years (Fig. 5), shows that recruitment of fawns in numbers averaging 20-25 percent of early winter populations has been necessary to maintain stability; though the exact numbers and proportions vary somewhat with the sex and age structure of the population and other factors influencing mortality patterns and rates. Recruitment amounting to 24-28 percent was sufficient to provide for moderate increases in numbers of

adult females in the population from 1972-73 through 1974-75 and a substantial increase from 1976-77 to 1977-78. However, recruitment of about 8 percent fawns to early winter 1975-76 served only to approximately maintain numbers of adult females from 1975-76 to 1976-77. The 17 percent fawns occurring in early winter 1974-75 were largely lost later that winter and, combined with above average adult mortality, resulted in a sharp decline in adult female numbers to early winter 1975-76.

Among males, with higher mortality, fawn recruitment of about 28 percent and 24 percent in 1972-73 and 1973-74, respectively, apparently was sufficient to maintain approximately stable numbers through early winter 1974-75. The 17 percent in 1974-75, combined with later mortality, and the 8 percent in 1975-76 were not sufficient to replace adult losses in those years; and even the 25 percent fawns in the 1976-77 population was not able to replace numerically the very high mortality of adult males in the fall of 1977. Because of this, the male segment of the population continued to decline from 1975-76 through 1977-78 while females remained stable and increased sharply in numbers through these two years.

The age structure of the population appears to have had one further influence on recent trends. The distribution of animals in the various age classes among animals handled in traps (Table 14) indicated that especially large numbers of both males and females occurred in certain year classes. In the 1977-78 winter, 6½ through 8½-year-olds were especially common among females; while the previous year, 1976-77, saw a predominance of 5½ years through 7½ years of age among animals of both sexes. These apparently reflected "strong" year classes of fawns born in 1969, 1970 and 1971. Although classifications were not obtained for 1969 and 1970, age ratios for 1971, derived from aerial surveys in early January 1972, showed 68 fawns:100 females (45:100 adults); the highest recorded in early winter during this study. Fawns born in 1969, 1970 and 1971 endured the very severe 1974-75 winter as 3, 4 and 5-year-old animals; age classes in which animals of both sexes seem to experience very low mortality. With the loss of most fawns and very old adults that winter, plus low production and survival of fawns in 1975, these animals comprised a significant proportion of adult populations in 1975, 1976 and 1977. They were especially prominent in the male segment, which normally includes only 7 age classes plus fawns. Because of this, they provided the bulk of the harvest during those years. The very heavy harvest of males in the fall of 1977, combined with almost complete removal of the remainder of the oldest age class during the following winter, severely decimated this group and thus total numbers of males in the population as well. It follows that, with continued hunter harvest and movement of the 1970 year class out of the male population in 1978-79, this segment of the population will be comprised almost entirely of yearlings and two-year-old animals by the spring of 1979. The future trend in numbers of males in the population will be determined by survival of these animals plus fawns produced in 1978 and following years. Numbers of females on the other hand might be expected to continue to increase, even with only moderate fawn production and survival, for the next two to three years, until the mortality rate among females increases as current 7, 8 and 9-year-old does begin to leave the population.

Fawn Production and Survival

Aerial classifications of deer on the Armstrong range during helicopter surveys in mid-December 1977 and early April 1978 were listed in Table 12 with comparable data for previous years. As noted earlier, the 47 fawns: 100 females and 42 fawns:100 adults were the highest ratios recorded on the area since January 1972. The 25 fawns:100 adults observed in April was lower than the ratio recorded in late winter 1977, but higher than ratios recorded for the same time in any previous year including 1971-72 when the highest early winter ratios were observed. However, when trends in relative proportions of males and females in the population (Table 10) are considered, late winter ratios compare less favorably. Fawn:female ratios calculated from late winter population estimates show about 40 fawns:100 females in the spring of 1973, 31:100 in 1974, 5:100 in 1975, 10:100 in 1976, 42:100 in 1977, and 27:100 in 1978. In this light, survival to late winter was much lower as compared with previous years than indicated by comparisons of late winter fawn:adult ratios, and was lower than other years except 1975 and 1976.

Overwinter mortality of fawns during 1977-78 approached 50 percent, and was more extensive than indicated by comparison of early and late winter fawn:adult or fawn:female ratios. Mortality during previous winters has ranged from little or none (1976-77) to 85-90 percent (1974-75).

In utero production for 23 female mule deer collected in the Bridger Mountains between 1973 and 1978 has averaged 144 fetuses per 100 females 2.5-years of age and older, and 125:100 for yearling females. Reproductive data for individual females examined are listed in Apprendix Table 16. Although sample sizes are rather limited, these data suggest an overall fetal rate somewhat lower than reported for mule deer on most other ranges in Montana and elsewhere (Knowles 1977). When the potential for the Bridger Range is compared with realized reproduction to early winter on the Armstrong range from 1971-72 through 1977-78, substantial mortality between parturition and early winter is evident and may be characteristic of this range and population. Data on fawns in the population during summer and fall are limited or lacking for most years. Pac (1976) found considerable fawn mortality to occur in late fall during 1975.

During early winter 1977-78, 5 (46 percent) of 11 males observed were yearlings. This compared with 3 (21 percent) of 15 males observed in early January 1977. While higher recruitment and survival of yearlings through their first fall is indicated for 1977-78, yearling recruitment to and through the 1977-78 winter was numerically low. Only 8 yearling males were believed to occur in the Armstrong population in early winter and 6 survived to April.

General Population Characteristics of Bridger Mountain Mule Deer

Numbers of mule deer classified during aerial surveys in 1977-78 and/or previous years (Table 5) provide basis for minimal general estimates of mule deer numbers and densities associated with major winter ranges and the Bridger Range. During early winter, 1977-78, a total of 4,060 mule

deer was classified during intensive helicopter surveys and 109 additional deer were seen from the ground and from a fixed wing aircraft during January in local areas not covered by the general survey. Excluding the 910 recorded on winter range north of 16-Mile Creek, a total of 3,259 mule deer was associated with the Bridger complex. However, a comparison of numbers of deer seen on individual winter ranges, especially the north and south portions of the west slope, during 1977-78 and previous years suggested that many more deer may have been present but were not observed and counted.

In late winter 1975, 1,048 mule deer were seen along the west slope as compared with 661 in 1978. The former included 600 on the north end, of which 181 were on the Armstrong range where essentially all of the deer present were believed counted (Mackie et al. 1976). In late winter 1978, only about 11 percent fewer deer occurred on the Armstrong range than during the 1975 survey. Assuming the same counting accuracy for the entire north end and a similar population trend, as many as 535 mule deer could have occurred in 1978 as compared with 315 actually counted. This would indicate that the observational efficiency of the 1978 survey was about 59 percent.

Comparisons of aerial counts in the vicinity of the Armstrong range with numbers of mule deer estimated by other means have indicated that the aerial surveys in most cases count only 50-75 percent of the deer present. For example, the efficiency of the 1978 late winter count appeared to be about 57 percent, or very similar to the 59 percent estimated above. These data have also indicated that early winter surveys generally result in proportionately fewer deer counted than late winter surveys; the difference averaging about 10-12 percent. Thus, if only 47 percent of the deer present on the north end in early winter 1977-78 were counted, approximately 690 would have occurred when 325 were observed. Overwinter mortality of about 25 percent, as observed on the Armstrong winter range, would have reduced this number to about 510 in late winter 1978; only slightly fewer than estimated on the basis of 59 percent sampling efficiency in late winter.

If the 3,259 deer counted on all winter ranges in the Bridgers during early winter 1978 were observed at the same sampling efficiency as those on the Armstrong range, as many as 6,800 mule deer could have occurred. This would represent about 48 animals per square mile of winter range, or about 1 deer per 13 acres. This probably is not the case, however, as the steep, topographically complex, and moderately timbered west slope winter ranges seem to be the most difficult areas to survey effectively. In contrast, the extensive open east side ranges may be surveyed with a high degree of efficiency, especially during winters like 1977-78 when most deer were distributed below the zone of extensive timber cover. The vegetatively diverse 16-Mile Creek winter range seems to be about intermediate to east and west slope ranges with respect to accuracy of aerial counts. If we were to assume from this that some "intermediate" degree of counting efficiency, perhaps 65-70 percent, were to apply to early winter surveys over the entire Bridger complex, a perhaps more reasonable estimate of 4,500-5,000 total mule deer is obtained from the 1977-78 count. This would be a mean density of about 32-35 deer per square mile of winter range or 1 deer per 18-20 acres.

Among the individual winter ranges, early and late winter observations during 1977-78 resulted in classification of 325 and 315 mule deer, respectively on the north end of the west slope. Observed densities were about 67 and 65 deer per square mile of winter range for the two surveys. However, as indicated above, 650 to 700 deer may actually have been present in early winter, or nearly 140/mi^2; in late winter, 500-550 may have remained, or some 100-110/mi^2.

Corresponding observations on the south end of the west slope resulted in observations of 336 deer in early winter and 121 during a very incomplete survey in April (Table 5). Because counting efficiency in this area is equal or even lower than on the north end, total numbers of deer using this range probably equal or exceed those on the former. An early winter population of about 700 deer would represent a density of nearly 80/mi^2, or somewhat less than on the north end. The observed density in early winter was 37 deer/mi^2.

The 221 mule deer observed on the Blacktail Mountain range in early winter comprised an observed density of about 60/mi^2 of winter range area. At an efficiency rate similar to the Armstrong range, as many as 450 animals may have been using this area; a density of more than 120/mi^2 . The late winter survey was very incomplete.

A total of 543 mule deer was observed on the south 16-Mile range, or about 21/mi^2 of available winter range. Including the north portion, 1,463 deer were recorded for a mean density of 25/mi^2. If two-thirds of the deer were seen during the early winter survey, as many as 800 deer may have been using the south portion and more than 2,000 may have occurred over the entire area. These numbers would reflect densities of 32 and 35 per square mile of winter range, respectively. Only the north area was covered in late winter when 1,050 mule deer, 140 more than in early winter, were observed.

The 388 mule deer (14/mi^2) observed on Battle Ridge in early winter may represent 75-80 percent of the total. If so, as many as 500 (18/mi^2) could have occurred. The areas was not re-surveyed in late winter.

The 978 deer recorded on the Brackett Creek range represented an observed density of about 25/mi^2. It is possible that as many as 1,200 deer could have occurred for a total density of 31/mi^2 of available winter range. This area was not surveyed completely in late winter 1978.

Early winter surveys of the Livingston winter range provided observations of 266 deer, or about 9/mi^2. Deer are not generally distributed across this area, however; and the west portion is characterized by steep terrain with scattered tree-shrub cover. It is possible that as many as 400-500 mule deer occur on the area at densities of 14-18/mi^2, or similar to those on the Battle Ridge winter range. The latter area also includes considerable area which apparently receives little or only occasional use by mule deer.

Like the Armstrong winter range (Mackie et al. 1976), other west slope winter range areas characteristically are occupied by high density mule

deer populations during winter. Densities appear to be generally much lower on the extensive open east side winter ranges as well as in the 16-Mile Basin. Although density distributions on individual winter ranges appear to reflect a rather high inverse relationship to the amount of winter range area available, additional data from comparative deer population and habitat studies is required to assess possible reasons for the differences.

The approximately 4,500 (4,200-4,800) mule deer, which occurred during early winter 1977-78, represent a density of about 10 animals per square mile of yearlong habitat within the Bridger complex, including all of the area above 5,600 ft. elevation (Fig. 3) and portions of the south 16-Mile and other areas of lower elevation which may be used more or less continuously during summer. Somewhat higher densities would be expected during summer and fall before the hunting season and the apparent late summer fall mortality of fawns. It might also be noted that these data are for a population or populations in the early stages of recovery from generally low numbers during the period from 1974 to 1977, and especially during 1976.

Because of variability in coverage and timing of winter surveys as well as in weather conditions and other factors which influenced the distribution of deer and the efficiency of aerial counts, numbers of deer observed (Table 5) between years cannot be interpreted directly as measuring population trends. Yet the generally higher numbers recorded on most areas in early winter 1977-78 as compared with highest previous totals and on the few areas where intensive surveys were conducted during both early and late winter suggests that at least some increase in populations has occurred. Increased numbers along the west slope to early winter 1977-78 were indicated by studies on the Armstrong range discussed earlier. General increases would also be indicated by relatively high proportions of fawns in all areas. The most substantial increases would appear to have occurred on the east side ranges, and possibly on the north end of the Bridger Range, where early winter fawn:female ratios were high (Table 5), while lesser change was indicated for west slope areas in general. Moderate to heavy mortality over winter in some areas along the west slope and light to moderate winter mortality on other ranges may have negated early increases on the former and dampened increases on the latter, however.

Sex and age ratios derived from aerial surveys and classifications (Table 5) have indicated some differences between populations associated with individual winter ranges as well as generally among deer on the west slope, east side and north end areas. West slope ranges in general have been characterized by relatively high proportions of males in their mule deer populations and by generally low fawn:doe and fawn:adult ratios. Populations on the north end and east side ranges characteristically have included relatively few males and somewhat higher fawn:female and fawn:adult ratios; and they appear to have been more variable with respect to proportions of fawns between years. Again, however, existing data are not sufficient to evaluate possible reasons for these differences or their significance. Additional information from 1978-79 and from intensive studies underway on the Brackett Creek area (Nyberg 1978) may provide some insight which can be considered in future

reports. Differences in population characteristics of mule deer associated with the various winter ranges, however, support the suggestion made earlier that animals associated with these areas comprise rather discrete population units associated with distinct and definable herd ranges within the Bridger Mountain complex.

LITERATURE CITED

Bucsis, R. A. 1974. Ecological characteristics of the Armstrong mule deer winter range, Bridger Mountains, Montana. Unpubl. Masters Thesis (M.S.). Montana State University, Bozeman. 104 pp.

Clover, M. R. 1954. A portable trap and catch-net. Calif. Fish and Game 40(4):367-373.

Constan, K. J. 1975. Big game inventory and plan. In: Fish and Game Planning, Upper Yellowstone and Shields River Drainages. Montana Fish and Game Dept. Environment and Information Division. Fed. Aid to Fish and Wildlife Restoration Project -FW-3-R. 234 pp.

Hamlin, K. L. 1974. Ecological relationships of mule deer in the Bridger Mountains, Montana, with special reference to daily and seasonal movements. Unpubl. Masters Thesis (M.S.), Montana State University, Bozeman. 65 pp.

_____. 1977. Population dynamics and habitat relationships of mule deer in the Bridger Mountains, Montana, 1955-1976. Ann. Conf. NW Section The Wildlife Society, Kalispell, MT. Feb. 17-78, 1977. Typewritten.

Jorgensen, H. E. 1977. Habitat Classification of Park and Prairie County mule deer ranges. In: Statewide Habitat Research. Job Prog. Rept., Fed. Aid Proj. W-120-R-8, Study No. A-1.1. pp 33-41.

Mackie, R. J., J. G. Mundinger, K. L. Hamlin and W. F. Schwarzkoph. 1975. Use and effectiveness of four different trapping methods for mule deer on winter range in the Bridger Mountains, Montana. Job Prog. Rept., Montana Fish and Game Dept., Fed. Aid Proj. W-120-R. 9 pp. Multilith.

_____, K. L. Hamlin, and J. G. Mundinger. 1976. Habitat relationships of mule deer in the Bridger Mountains, Montana. Job Prog. Rept., Montana Fish and Game Dept., Fed. Aid Proj. W-120-R-6, Job No. BG-2.01 (Supplement). 46 pp. Multilith.

_____ and S. T. Stewart. 1976. Population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana. Job Prog. Rept. Fed. Aid Proj. W-120-R-7, Study BG-1.2, pp. 41-62, Montana Deer Studies 1975-1976. Montana Fish and Game Dept. 170 pp.

_____ and C. J. Knowles. 1977. Population ecology and habitat relationships of mule deer in the Bridger Mountains, Montana. Job Prog. Rept. Fed. Aid Proj. W-120-R-8, Study BG-1.2, pp 47-74, Montana Deer Studies 1976-77. Montana Fish and Game Dept. 168 pp.

_____. 1978. Natural Regulation of mule deer populations. 1978 Symposium of the Northwest Section of Wildlife Society. Vancouver, B.C. March 10, 1978.

McMannis, W. J. 1955. Geology of the Bridger Range, Montana. New York Geological Society of America, Bull. Vol. 66:1385-1430.

Morton, Mary A. 1976. Nutritional values of major mule deer winter forage species in the Bridger Mountains, Montana. Unpubl. Masters Thesis (M.S.), Montana State University, Bozeman. 104 pp.

Mueggler, W. F. and W. P. Handl. 1974. Mountain grassland and shrubland habitat types of western Montana. U.S.D.A. Forest Service. Intermountain Forest and Range Experiment Station and Region 1. 89 pp.

Nyberg, H. E. 1978. Distribution, movements, and habitat use of mule deer associated with the Brackett Creek winter range, Bridger Mountains, Montana. In: Montana Deer Studies Job. Compl. Rept. Mont. Fed. Aid Prog. W-120-R-9. pp 133-139.

Overton, W. S., and D. E. Davis. 1969. Estimating the numbers of animals in wildlife populations. Pp. 403-455. In: R. H. Giles (Editor) Wildlife Management Techniques. 3rd ed. Printed for the Wildlife Society by Edwards Brothers, Inc. Ann Arbor, Michigan. 623 pp.

Pac, D. F. 1976. Distribution, movements and habitat use during spring, summer and fall by mule deer associated with the Armstrong winter range, Bridger Mountains, Montana. Unpubl. Thesis (M.S.) Montana State University, Bozeman. 120 pp.

Pfister, R. D., B. L. Kovalchik, S. F. Arno, and R. C. Presby. 1977. Forest Habitat types of Montana. U.S.D.A. For. Serv. Gen. Tech. Rept. INT-34, 174 p. Intermountain Forest and Range Experiment Station, Ogden, Utah 84401.

Picton, H. D. and R. R. Knight. 1969. A numerical index of winter conditions of use in big game management. Proc. symp. on snow and ice in relation to wildlife and recreation. Iowa State Univ., Ames. pp:29-38.

Robinette, W. L., D. A. Jones, C. Rogers, and J. S. Gashwiler. 1957. Notes on tooth development and wear for Rocky Mountain mule deer. J. Wildl. Manage. 21(2):134-153.

Schladweiler, P. 1975-1978. Coyote densities, small mammal population indices, and big game fawn production and survival in the various study areas. Job Prog. Rept. Montana Fish and Game Dept. Fed Aid Proj. W-120-R-8 Study No. NG-47.1.

Schwarzkoph, W. F. 1973. Range use and relationships of mule deer on the west slope of the Bridger Mountains, Montana. Unpubl. Masters Thesis (M.S.), Montana State University, Bozeman. 65 pp.

Steerey, W.F. 1977. Habitat relationships of mule deer associated with the Schafer Creek winter range, Bridger Mountains, Montana. In: Montana Deer Studies. Job Compl. Rept. Mont. Fed. Aid Proj. W-120-R-8., pp. 79-81.

Wilkins, B.T. 1957. Range use, food habits, and agricultural relationships of the mule deer, Bridger Mountains, Montana. J. Wildl. Manage. 21(2):159-169.

Youmans, H. B. 1977. Habitat selection of radio-marked mule deer on the Armstrong winter range, Bridger Mountains, Montana. In: Montana Deer Studies. Job Compl. Rept. Mont. Fed. Aid Proj. W-120-R-8., pp 75-78.

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Appendix Table 15. List and current status of radio-collared deer on the Armstrong range.

Radio No.	Animal No.	Sex	Age[1]	Date Collared	Collar Type	Trans. Freq.[2]	Remarks/ Status
1	14-73	F	3½+	2-10-73	Belt	M-4	Failed immediately
2	7-74	F	Mat	4-16-74	Tygon	M-4	Failed? Never relocated
3	8-74	F	Mat	4-16-74	Tygon	M-8	Failed May 1974
4	3-72	F	6½+	3-6-75	Tygon	AVM-3/4	Failed June 1978
5	34-74	F	Mat	3-29-75	Tygon	AVM-6	Winterkill May 31, 1975
6	41-74	F	Mat	3-29-75	Tygon	AVM-1	Winterkill May 2, 1975
7	16-75	F	2½+	4-9-75	Tygon	AVM-8	Failed late July 1976, recollared 1/29/78
8	17-75	F	3½+	4-10-75	Tygon	AVM-2	Failed mid-August 1976
9	20-75	F	5½+	4-13-75	Tygon	AVM-11	Shot by hunter 10/29/75
10	27-75	F	3½+	4-24-75	Tygon	AVM-12	Winterkill May 13, 1975
11	9-73	F	7½+	5-8-75	Tygon	AVM-6	Died December 1977
12	1-76	M	5½+	2-22-76	Tygon	AVM-6	Died March 1978
13	2-76	M	6½+	2-22-76	Tygon	AVM-1	Failed late June 1976
14	2-72	M	4½	2-25-76	Tygon	AVM-4	Shot by hunter 10/30/76
15	6-75	M	5½	2-27-76	2" PVC	AVM 2-8	Died December 1977
16	1-75	F	1½	3-3-76	Tygon	AVM-11	Recollared 1/24/78
17	1-73	F	4½+	3-16-76	Tygon	AVM-5	Recollared 2/16/78, died March 1978
18	11-73	F	6½+	3-16-76	Tygon	AVM-10	Failed December 1977
19	2-74	M	Mat	3-25-76	Tygon	AVM-7	Failed November 1976, shot by hunter 10/30/77

Appendix Table 15 (continued).

Radio No.	Animal No.	Sex	Age[1]	Date Collared	Collar Type	Trans. Freq.[2]	Remarks/ Status
20	7-76	F	Mat	3-27-76	Tygon	AVM-9	Failed January, 1977, re-collared 1/23/78
21	1-77	F	Mat	1-31-77	1½" PVC	AVM-3	Failed June 1978
22	8-75	M	Mat	3-3-77	Tygon	AVM-8	Shot by hunter 11/26/77
23	19-74	F	Mat	3-5-77	2" PVC	AVM-1	Ok through summer 1978
24	12-73	M	6½	3-20-77	Tygon	AVM-7	Died March 1978
25	4-77	F	8½+	3-22-77	1½" PVC	AVM 2-5	Died April 1978
26	35-75	M	6½+	4-2-77	Tygon	AVM-5	Died April/May 1977
27	1-78	F	6½+	1-21-78	1½" PVC	AVM 1-12	Ok through summer 1978
28	7-78	M	1½	1-25-78	1½" PVC	AVM 1-1	Ok through summer 1978
29	13-78	F	5½	3-17-78	1½" PVC	AVM 2-1	Ok through summer 1978
30	20-78	F	5½+	2-4-78	1½" PVC	AVM 2-4	Ok through summer 1978
31	40-78	F	1/2	4-24-78	1½" PVC	AVM 1-7	Ok through summer 1978
32	41-78	F	6½+	4-24-78	1½" PVC	AVM 2-5	Ok through summer 1978
33	42-78	F	6½+	4-24-78	1½" PVC	AVM 1-11	Failed June 1978

[1] Estimated or known age when radio collar attached, several were radio-equipped as recaptures of earlier collared deer; e.g. No.'s 14-73, 3-72, etc.

[2] M = Markusen Electronics; AVM = AVM Electronics. AVM Channels 1-12 as designated for single band receiver. Other AVM channel designations are from four band receiver.

Appendix Table 16. Reproductive status of 23 mule deer females from the Bridger Mountains.

Collection Date	Location	Age of Female	Number of Fetuses	Sex of Fetuses	No. Corpora Lutea of Pregnancy	Fetus Crown-Rump Measurement (cms.)	Fetus Weight (gms.)	Estimated Date of Conception
4-16-73	Armstrong Winter Range	8-12	1	M	1	26.8	589	Dec. 1
4-22-73	Armstrong Winter Range	8-12	1	F	1	31.5	941	Nov. 28
2-22-75	Armstrong Winter Range	1/2	-	-	-	-	-	-
3-18-75	Armstrong Winter Range	12	1	F	2	23.0	336	Nov. 18
3-29-75	Armstrong Winter Range	4½	2	M	2	23.5	399	Nov. 28
				F		23.0	424	Nov. 28
4-14-75*	Armstrong Winter Range	14	1	M	1	21.0	239	Dec. 22
5-3-75**	Armstrong Winter Range	12	0	-	2	-	-	-
5-12-75	Armstrong Winter Range	12	2	F	2	30.0	796	Dec. 20
				F		29.0	731	Dec. 20
5-12-75	Armstrong Winter Range	5	2	M	2	37.0	1,450	Dec. 1
				M		37.0	1,591	Dec. 1
5-14-75	Armstrong Winter Range	6	2	M	2	34.0	975	Dec. 10
				F		34.0	791	Dec. 10
3-21-77	Schafer Creek Winter Range	8-10	2	F	2	25.0	368	Nov. 14
				F		24.5	395	Nov. 14

Appendix Table 16 (continued).

Collection Date	Location	Age of Female	Number of Fetuses	Sex of Fetuses	No. Corpora Lutea of Pregnancy	Fetus Crown-Rump Measurement (cms.)	Fetus Weight (gms.)	Estimated Date of Conception
3-23-77	Schafer Creek Winter Range	5½	2	F	2	28.0	649	Nov. 17
				F		28.0	638	Nov. 17
June/1977	Schafer Creek Winter Range	8+	2	-	-	-	-	-
1-30-78	Armstrong Winter Range	1½	1	M	1	5.3	-	Dec. 6
1-31-78	Armstrong Winter Range	5½	1	M	2	11.5	-	Nov. 18
2-5-78	Armstrong Winter Range	1½	1	M	1	4.0	-	Nov. 17
3-7-78	Armstrong Winter Range	8½	1	F	2	22.0	-	Nov. 17
3-15-78	Mouth of Bridger Canyon	4½	2	M	-	20.0	-	Dec. 7
				F		-		-
3-16-78	Bear Canyon	8	2	F	2	21.3	252	Nov. 30
				F		21.4	278	Nov. 30
3-31-78	Brackett Creek Winter Range	1½	2	M	2	22.0	-	Dec. 11
				F		22.8	-	Dec. 11
4-10-78	Brackett Creek Winter Range	5½	1	F	2	29.4	-	Nov. 27
4-20-78	Armstrong Winter Range	8½	1	F	1	20.5	-	Jan. 7
4-24-78	Armstrong Winter Range	1½	1	M	1	31.3	-	Dec. 8

*evidence of absorption of 1 fawn, 1 ovary atrophied.
**this doe had apparently aborted or resorbed its fetuses.

Appendix Table 17. Mortality pattern among male mule deer marked on the Armstrong winter range, 1972-1978. Data are numbers of each age when marked that died the same year or a subsequent year. W = Winterkill, S = Shot by Hunter, P = Predator Kill, T = Trap Casualty, U = Unknown.

Age Mkd.	No. Mkd.	No. Dead	Age at Death											
			½	1½	2½	3½	4½	5½	6½	7½	8½	9½	10½+
½	14	10	4W 1T	2S	1S	0	1S	1S	0	0	0	0	0
1½	8	3	--	1W	1S	0	1S	0	0	0	0	0	0
2½	5	3	--	--	1W	1S	0	1S	0	0	0	0	0
3½	3	2	--	--	--	0	1S	0	0	0	1W	0	0
4½	5	2	--	--	--	--	0	0	0	1P 1S	0	0	0
5½	3	3	--	--	--	--	--	0	0	2S 1TW	0	0	0
6½	2	1	--	--	--	--	--	--	0	1TW	0	0	0
7½	3	2	--	--	--	--	--	--	--	0	1S	0	1S
8½	0	0	--	--	--	--	--	--	--	--	0	0	0
9½	1	1	--	--	--	--	--	--	--	--	--	1W	0
10+	0	0	--	--	--	--	--	--	--	--	--	--	0
Total	44[1]	27	5	3	3	1	3	2	0	6	2	1	1

[1]Total does not include 6 males "aged" only as adult at the time of trapping. None of these is known dead.

Appendix Table 18. Mortality pattern among female mule deer marked on the Armstrong winter range, 1972-1978. Data are numbers of each age when marked that died the same year or a subsequent year. W = Winterkill, S = Shot by Hunter, p = Predator Kill, T = Trap Casualty, U = Unknown.

Age Mkd.	No. Mkd.	No. Dead	½	1½	2½	3½	4½	5½	6½	7½	8½	9½	10½+
½	10	3	1P	1W 1T	0	0	0	0	0	0	0	0	0
1½	8	0	--	0	0	0	0	0	0	0	0	0	0
2½	6	1	--	--	0	0	1T	0	0	0	0	0	0
3½	16	5	--	--	--	2W	1W	0	0	1P	1T	0	0
4½	9	0	--	--	--	--	0	0	0	0	0	0	0
5½	12	4	--	--	--	--	--	2W	1S	0	0	0	1U
6½	13	0	--	--	--	--	--	--	0	0	0	0	0
7½	3	2	--	--	--	--	--	--	--	--	2W	0	0
8½	7	2	--	--	--	--	--	--	--	--	1W	1U	0
9½	3	1	--	--	--	--	--	--	--	--	--	--	1U
10+	4	4	--	--	--	--	--	--	--	--	--	--	4W
Total	91[1]	22	1	2	0	2	2	2	1	1	4	1	6

[1]Total does not include 17 females "aged" only as adult at the time of trapping. None of these is known dead.

Job Title: Habitat selection of radio-marked mule deer on the Armstrong winter range, Bridger Mountains, Montana.

Job Objectives: To determine the extent to which individual deer vary in their use of winter habitats; and to evaluate the reliability of observational data in indicating relative use and importance of various habitat types by mule deer during winter.

Findings:

This study is being conducted in cooperation with Montana Department of Fish and Game Region Three Deer Surveys and Investigations and the Montana State University Agricultural Experiment Station. Field work has been completed and the final thesis report is being prepared to be submitted as a supplementary research progress report on Bridger Mountain Deer Studies during early winter. An abstract of the thesis by Heidi Youmans will be included in the 1978-79 Deer Studies Progress Report.

Job Title: Habitat relationships of mule deer associated with the Schafer Creek winter range, Bridger Mountains, Montana.

Job Objectives: To determine and describe seasonal habitats and habitat use of mule deer associated with the Schafer Creek winter range; and to compare habitats, habitat usage, and habitat relationships of mule deer on the Schafer Creek Range with those of mule deer on the Armstrong range.

Findings:

This study was conducted in cooperation with Montana Department of Fish and Game Region Three Deer Surveys and Investigations Project, as a supplement to the Bridger Mountain deer study. Field work has been completed and the Final Thesis Report is being prepared to be submitted as a supplementary research progress report during early winter. An abstract of the thesis by William Steerey will be included in the 1978-79 Deer Studies Progress Report.

JOB TITLE Distribution, movements and habitat use of mule deer associated with the Brackett Creek winter range, Bridger Mountains, Montana.

ABSTRACT

A study was initiated in January 1978 to determine the movements, distribution and habitat use of mule deer associated with the Brackett Creek winter range on the east side of the Bridger Mountains. This report summarizes the methods to be employed in the study and results of work completed through June 1978. Thirty-one mule deer were trapped and marked. The summer distribution of the instrumented deer is presented.

Job Title: Distribution, movements and habitat use of mule deer associated with the Brackett Creek Winter Range, Bridger Mountains, Montana.

Job Objectives: To determine the movements, distribution and habitat use of mule deer associated with the Brackett Creek Winter Range and compare the results of this study with similar studies conducted on the Armstrong and Schafer Creek Winter Ranges on the west slope of the Bridger Mountains and elsewhere.

To prepare cover type and habitat type maps of the vegetation of the study area.

To determine population characteristics of the Brackett Creek deer herd in comparison with those of other mule deer populations in the Bridger Mountains and elsewhere.

INTRODUCTION

Movements, distribution, habitat use and population dynamics of mule deer have been studied extensively on the west slope of the Bridger Mountain Range since 1957 (Wilkins 1957; Schwarzkopf 1973; Hamlin 1974; Pac 1976; Steerey 1978; Youmans 1978). Aside from aerial surveys conducted periodically in winter since 1974, mule deer wintering along the east slope of the Bridger Range complex have not been studied. The Brackett Creek study area differs ecologically from west slope range, and affords an opportunity to compare range use and population parameters for mule deer between two adjacent, but ecologically different, habitat types. This report summarizes the methods to be employed in achieving study objectives and the results of field studies through and including the early part of the summer field season, 1978. The study is being conducted as a master's thesis research project. Field work will continue through March 1979.

Study Area

The study area is located on the Bangtail Ridge, one of two main accessory ridges of the Bridger Mountain Range located in southwestern Montana near Bozeman in Gallatin County, and its associated winter range. The Bangtail Ridge extends approximately 12 airline miles southeast from the confluence of the three forks of Brackett Creek. The study area (Fig. 1) consists of a band approximately 6 miles by 15 miles bounded by Highway 293, the Brackett Creek road, the Shields River and a line connecting the Stone Creek-School Gulch divide with the Bangtail Creek-North Fork Flatwillow Creek divide. Vegetation varies from dense coniferous forests to open sagebrush plains. A more complete description of the study area will be given in the final job report.

Methods

The movements, distribution and habitat use of mule deer associated with the Brackett Creek Winter Range are being studied through observation and

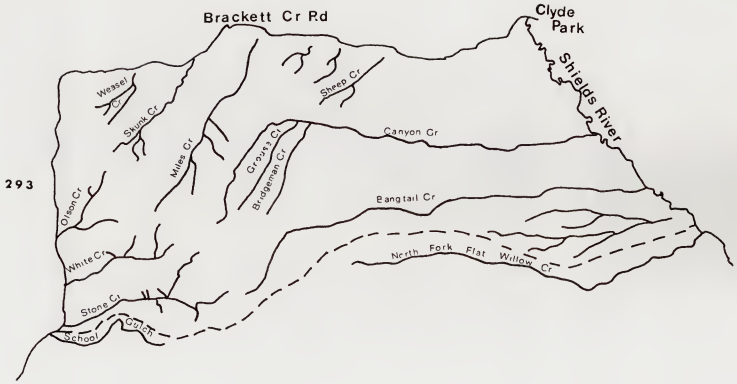


Figure 1. Map of the Brackett Creek study area.

relocation of marked and unmarked deer. Deer were captured, marked and released by the cannon net method as described by Mackie et al. (1976). Selected animals were instrumented with radio transmitter collars. The remainder of the deer were neckbanded with four-inch vinyl (Armortite material) collars bearing tuflex painted symbols. All deer received two metal ear tags for identification in the event of neckband loss.

Basic movement and distributional data were gathered through weekly aerial relocation flights and ground tracking of radioed deer. Habitat use information was gathered through aerial and ground relocations of radio marked deer, observations of unmarked deer and extended observation of selected radioed deer.

Deer feeding sites will be examined to determine deer forage preference and selection. Plant species used and numbers of instances of use will be recorded. Supplementary food habits data may be provided by analyses of rumen contents of deer killed or found dead on the study area.

The vegetation of the study area will be mapped with respect to both cover and habitat types. To cover type the area, representative air photo units will be visited and subjectively described by ocular reconnaissance. The dominant plants, in terms of canopy cover, will be recorded as the cover type for that site. The remainder of the plant species on the site will be listed in order of abundance to the extent possible without quantitative sampling. Photo units similar to those visited initially will then be visited to determine the predictability of cover types based on air photo units. This information will be incorporated into a map of the current vegetative cover of the area. Habitat types will be assigned, on the basis of information gathered above, according to the vegetation classification systems of Pfister et al. (1974) for forested habitats and Mueggler and Handl (1974) and Jorgensen (1977) for grassland and shrub habitats. A map showing the habitat types of the area will be made as above.

The population parameters of mule deer using the Brackett Creek Winter Range will be studied through two (helicopter) sex and age classification flights over the winter range, observations made during aerial relocation flights and ground tracking as well as random observations of deer seen on the study area. Results from these studies will be compared with those for other mule deer populations in the Bridger Mountains and other areas of Montana.

Results

Trapping was conducted during March and April 1978. Thirty-three mule deer were trapped of which 31 deer, 20 does and 11 bucks, were marked (Table 1). Two deer died as a result of injuries from handling during the trapping process. Twelve adult does (Table 2) were equipped with radio transmitters and the remainder were neckbanded. Of the thirty-one deer marked, two were subsequently killed; one buck fawn was an apparent road kill, the second also a buck fawn apparently was shot and left in a hay field along the Brackett Creek road.

Table 1. Sex and age characteristics of 33 mule deer trapped on the Brackett Creek (Bangtail) Winter Range during March and April 1978.

	Fawn	Adult
o	10	1
o	3	19

Table 2. Descriptions of radio marked deer.

Channel	Sex	Age	Location Trapped	Location of Summer Range
2/3.10	F	3½	Site 5	Miles Creek
2/6.25	F	5½	Site 3	White Creek
2/9.20	F	4½	Site 3	Not relocated
2/10.30	F	6½	Site 3	Miles Cr. - Radio stopped
2/11.20	F	Ad.	Site 3	Ward Ranch
2/12.25	F	4½	Site 4	Bangtail Creek
4/7.50	F	4½	Site 1	Radio stopped
4/8.30	F	4½	Site 5	Slushman Cr./Skunk Cr.
4/9.10	F	3½	Site 2	Scott Ranch (winter range)
4/10.10	F	6	Site 2	Stone Creek
4/11.20	F	6½	Site 3	Ward Ranch
4/12.15	F	6½	Site 4	Miles Creek
4/1.25	F	6½	Schafer Cr. W. R.	Weasel Creek

Aerial, fixed wing relocations were begun on May 2. Figure 2 presents the dispersal to the summer range. Three of the original twelve radioes cannot be relocated, one radio is known to have stopped working and the other two have either stopped working or the deer have left the study area.

One deer, Channel 4/1, marked on the Schafer Creek Winter Range on the west slope of the Bridger Mountains has crossed over to summer in the Weasel Creek drainage of the Brackett Creek study area.

The remainder of the summer has been spent in cover typing the area and extended observations of selected deer as well as weekly flights to relocate radioed deer.

Literature Cited

Hamlin, K. L. 1974. Ecological relationships of mule deer in the Bridger Mountains, Montana, with special reference to daily and seasonal movements. Unpubl. Masters Thesis, Montana State University, Bozeman. 65 pp.

Jorgensen, H.E. 1977. Habitat type classification of Park and Prairie County mule deer ranges. *In:* Habitat Research. Job Prog. Rpt., Mont. Fed. Aid Proj. W-120-R-8. pp. 33-43.

Mackie, R. J., K. L. Hamlin, C. J. Knowles, J. G. Mundinger. 1976. Montana Deer Studies. Job Prog. Rpt., Mont. Fed. Aid Proj. W-120-R-7. 170 pp.

Mueggler, W. F. and W. P. Handl. 1974. Mountain grassland and shrubland habitat types of western Montana. U.S.D.A. For. Serv. 89 pp.

Pac, D. F. 1976. Distribution, movements and habitat use during spring, summer and fall by mule deer associated with the Armstrong winter range, Bridger Mountains, Montana. Unpubl. Masters Thesis, Montana State University, Bozeman. 120 pp.

Pfister, R.D., B. L. Kovalchik, S. F. Arno, and R. C. Presby. 1974. Forest Habitat Types of Montana. U.S.D.A. For. Serv. 213 pp.

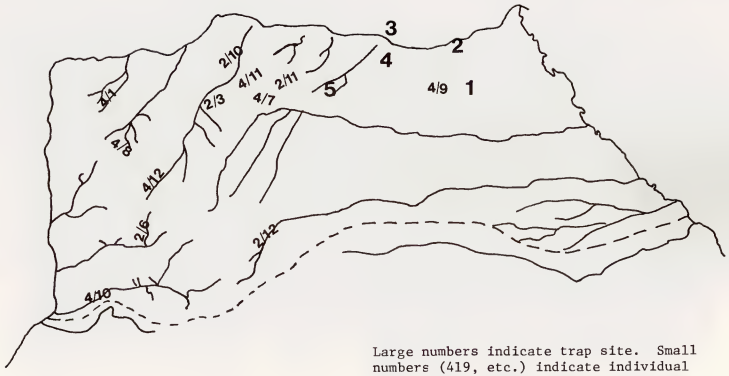
Schwarzkoph, W. F. 1973. Range use and relationships of mule deer on the west slope of the Bridger Mountains, Montana. Unpubl. Masters Thesis, Montana State University, Bozeman. 65 pp.

Steerey, W. 1978. Masters thesis in preparation. Montana State University, Bozeman.

Wilkins, B. T. 1957. Range use, food habits, and agricultural relationships of the mule deer, Bridger Mountains, Montana. J. Wildl. Manage. 21(2):159-169.

Youmans, H.B. 1978. Masters thesis in preparation. Montana State University, Bozeman.

Submitted by: Harvey E. Nyberg



Large numbers indicate trap site. Small numbers (419, etc.) indicate individual deer listed in Table 2.

Figure 2. Summer distribution of radioed deer.

Job Title Mule deer population ecology and habitat relationship in the Missouri River Breaks, Montana.

ABSTRACT

Information on mule deer populations in the Missouri River Breaks has been collected since 1960. This report summarizes some prior information and presents current information for the study areas. Mule deer numbers declined considerably during winter 1971-72, then declined slightly for several years, and in recent years remained relatively stable at a low level. The population decline which occurred during winter 1971-72 was probably caused by the deer herd entering a severe winter with low fat reserves; while subsequent decreases may have been caused by heavy either-sex hunting pressure during several seasons following the severe winter. During the last three years, however, hunting has been limited to bucks only without significant population response. Low recruitment of fawns has been the apparent reason for the lack of population resiliency. In recent years, minimum estimates of initial fawn production (150-165 fawns/100 producing females) have been near species potential while recruitment has been very low (11-30 fawns/100 adults). Fawn mortality during summer has been high, but variable, and no greater than that experienced in healthy populations. The major documented cause of summer fawn mortality on the Missouri River Breaks study area has been coyote predation. Continued high fawn mortality during fall and winter appears to have been the determining factor in keeping the population level low. There is little substantive knowledge of causes of fall-winter fawn mortality on the study area. Fawn mortality occurred during the extremely severe winter of 1977-78, but it was lower than the fawn mortality observed during the mild winter of 1975-76. Information from marked adult deer indicated that adult mortality was very low during winter. Available data indicate that the deer herd at present is in as good or better physical condition than the deer herd during 1960-64. During 1960-71, fawn survival to December appeared to be highly correlated with indicators of vegetation production. In the years since 1971, fawn survival to December was not highly correlated with indicators of vegetation production. Fall-winter food habits generally indicate greater use of rabbitbrush (*Chrysothamnus* spp.) and snowberry (*Symphorocarpos* spp.) and less use of big sagebrush (*Artemisia tridentata*) than during the 1960-64 period. Mule deer made considerable use of green grasses, primarily Sandberg bluegrass (*Poa sandbergii*) during fall green-up in 1977. Minimum home ranges for adult female mule deer ranged from 1170 acres to 2505 acres and averaged 1720 acres. The home range of one adult male was 5360 acres. While the density distribution of cattle and elk has remained generally the same, there has been a change in the distribution of mule deer densities since 1960-64. At present, the areas of highest mule deer density are those of least overlap with cattle and elk distributions. The effects of winter weather on deer and the reasons for the lack of population recovery after the decline of 1971-72 are discussed.

Job Title — Mule deer population ecology, habitat relationships, and relations to livestock grazing management and elk in the Missouri River Breaks, Montana.

Job Objective — To further determine the environmental requirements of mule deer and factors regulating mule deer populations in the "breaks" type of eastern Montana.

To further determine the direct and indirect effects of livestock grazing management under rest-rotational and continuous grazing systems upon deer populations and habitat relationships and upon deer-elk interrelationship in the "breaks" type.

To develop new and improved guidelines for management of mule deer populations and their habitats in the "breaks" type of eastern Montana and for consideration of deer habitat requirements in elk, livestock, and range management programs in this type.

INTRODUCTION:

In 1960, an intensive study of mule deer and their relationship to elk *(Cervus canadensis)* and domestic livestock was established on a representative 75,000 acre area in the Missouri River Breaks approximately 25 miles northeast of Roy, Montana. Habitat use and population studies were conducted from June 1960 through September 1963 and intermittently from October 1963 through May 1964 (Mackie 1970). From the summer of 1964 through spring 1975, less intensive studies were continued on the area primarily to obtain population data for mule deer (Mackie 1976). Mackie (1970) presented historical information on mule deer in the "Breaks", discussed development of the existing population from the late 1930's through the early 1950's, and described trends in numbers, sex and age composition and harvest from 1960 through winter-spring 1964. Subsequent reports (Mackie 1966, 1973 and 1976) extended these data through early winter 1975-76. In July 1975, intensive studies resumed under the statewide deer research program to further evaluate factors regulating mule deer populations in the breaks type habitat of eastern Montana.

A mule deer population decline on the study area, which started in winter 1971-72, continued to 1976-77 (Mackie 1976, Hamlin 1977). Population declines have occurred on this area in the past, but recovery has generally started within a year or two of the decline. Low fawn production and/or survival and ultimately low fawn recruitment was apparently the problem involved in the continuing population decline of the mule deer herd in recent years (Mackie 1976, Hamlin 1977). Low fawn ratios in some prior years were associated with severe environmental conditions such as drought in 1961-62 and severe winters in 1964-65 and 1971-72. However, severe environmental conditions apparently cannot be implicated in the relatively low fawn production and/or survival during the years 1973-76. From 1972 to 1976 normal precipitation during the growing season and mild, open winters have been the general rule (Mackie 1976).

A preliminary report by Knowles (1976) indicated that coyote predation may have been an important cause of mortality of mule deer, at least during winter 1975-76. A graduate student project investigating mortality of mule deer fawns from birth to September was initiated in June 1976. Dood (1978) indicated that coyote predation was implicated in at least some summer mortality of mule deer fawns on the south side Missouri Breaks study area.

Present work on the project emphasizes determination of fawn production and survival, population dynamics of the herd and causes and timing of mule deer mortality. This report will attempt to combine previous data with that obtained during the past two years and summarize information to date.

ACKNOWLEDGMENTS

The quantity and quality of data collected on this project has been greatly enhanced by the superior flying and observational skills of Supercub pilot Larry L. Schweitzer and helicopter pilot Murray Duffy. Dick Mackie has provided assistance and advice in all phases of the project and has supplied many years of prior data from the study area. Duane Pyrah has provided assistance and advice in all phases of the project. Others who have provided assistance in various ways include, but are not limited to: Arnold Dood, Shawn Riley, John Roseland, Craig Knowles and Marilyn Van Haur. The study is being conducted in part on lands comprising the Charles M. Russell Wildlife Range, administered by the U.S. Fish and Wildlife Service and in part on lands administered by the U.S. Bureau of Land Management and the East Indian Buttes Grazing District. The cooperation and assistance of these agencies in many aspects of the study, including financial support of aerial surveys, is gratefully acknowledged, as is the assistance of many individual personnel who contributed to the effort. Numerous private landowners and ranchers on the study area have also cooperated to assist the study effort through the years.

METHODS

Population data were obtained during fixed-wing (Piper Supercub) surveys in October and helicopter surveys during December and March. Sex and age classification and deer distribution and habitat use were obtained during all aerial surveys and population estimates were made using data during helicopter surveys. Information on deer and cattle distribution and habitat use were also obtained during aerial flights in July and September. Supplementary information was obtained throughout the year from the ground during the course of normal activities. Data on inital fawn production for deer were obtained in June during aerial and ground reconnaissance associated with fawn tagging. The river and reservoir ice was flown periodically during winter to check for coyote killed deer. Carcasses are listed as probable coyote kills based on evidence of tracks in the snow, trails of blood on snow or vegetation and other site evidence.

Aerial relocations of previously instrumented deer were obtained at 1-2 week intervals and relocations from the ground were made as often as possible.

Data on hunting mortality and physical measurements of deer were collected from check stations on a major access road during the first two weekends of the season, from field checks of hunters throughout the season and from voluntary hunter register boxes located along access roads.

Approximately 1 quart samples were obtained from rumens of deer killed by hunters, coyotes, and other undetermined causes for analysis of food habits.

Rain guages were serviced monthly and soil moisture readings were made at approximately two week intervals when the ground was not frozen. Old reports and unpublished data (Mackie pers. comm.) were consulted and incorporated into the present report when applicable.

STUDY AREA

The south study area encompasses all of the timbered "breaks" portion of the area described by Mackie (1970) as extending approximately 20 miles on a 4 to 7 mile wide belt adjacent to the Missouri River in Fergus County, Montana (Fig. 1). It comprised approximately 100 square miles between U.S. Highway 191 on the west, the Skyline Trail on the east, the Missouri River on the north and the Musselshell Trail on the south. Physiography, climate, land use and vegetation of this area were described in detail by Mackie (1970). Some of the work described in this report was conducted on the adjacent Missouri River Bottomlands described by Allen (1968) and NE across the river on the Nichols Coulee Resource Conservation Area (north study area) described by Knowles (1975).

WINTER WEATHER

Weather data for the period November through March and winter severity indicies (Picton and Knight 1969) for the Roy 8 NE weather station are presented in Table 1. Data are not available for computing weather severity indicies prior to 1968-69. Monthly weather data and 20 year averages are presented in Table 2.

These weather data indicate that winter 1977-78 was the most severe on record during the period of available records. In addition, discussions with long time residents of the area indicate that it was the most severe winter for a considerable period of time prior to 1968-69. Winter 1977-78 was colder than normal, but the most striking feature of the winter was the extremely long period of snow depth over 18 inches (Table 1).

This extreme winter, when compared with other winters and the available population data should help to explain the relationship between severe winters and deer population dynamics.

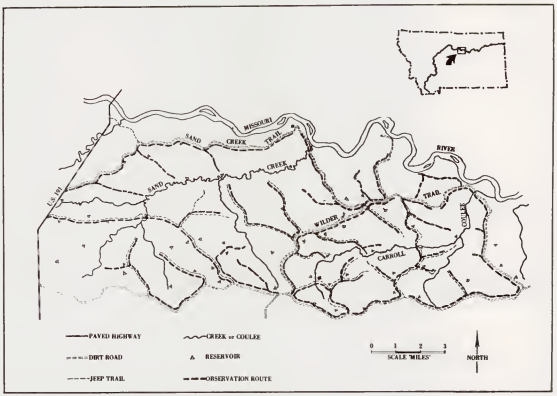


Figure 1. Map of the Study Area.

Table 1. Winter severity indicies and climatological data, Roy 8 NE, November through March 1968-1978.

Year	Average Temp. (F)	Total Snowfall (inches)	Maximum Depth (inches)	No. Days Snow on Ground	No. Days over 12 inches	No. Days over 18 inches	Severity[1] Index
1968-69	16.8	43	29	95	62	55	+23,108
1969-70	26.8	32	9	49	0	0	+ 118
1970-71	24.0	41	15	66	11	0	+ 3,504
1971-72	21.7	62	28	114	71	44	+17,518
1972-73	28.0	13	9	23	0	0	+ 1,226
1973-74	27.5	25	6	57	0	0	- 535
1974-75	26.0	36	19	54	0	0	+ 94
1975-76	29.3	42	9	51	5	0	+ 557
1976-77	29.2	60	21	57	24	5	+ 2,236
1977-78	19.0	86	56	128	108	90	+41,507

[1] + values indicate greater severity.

Table 2. Mean monthly temperatures, precipitation and 20 year means for temperature and precipitation, July-June. U.S. Department of Commerce Weather Service Station, Roy, 8 NE.

Month	Temperature (Degree F)			20 year mean	Precipitation (inches)			20 year mean
	1975-76	1976-77	1977-78		1975-76	1976-77	1977-78	
July	71.1	71.4	67.4	69.9	3.04	1.17	2.35	1.77
August	64.2	69.5	62.0	68.3	2.86	1.01	2.42	1.52
September	57.1	61.4	55.9	56.7	.39	1.13	2.14	1.06
October	46.9	44.7	47.9	47.3	1.37	.68	.64	.76
November	31.6	33.1	28.6	32.1	1.18	.62	.69	.54
December	25.9	29.9	16.4	22.0	.51	.16	1.91	.54
January	25.4	12.9	5.8	16.5	.13	1.23	1.29	.69
February	33.0	35.1	13.1	24.4	.67	.20	.91	.42
March	31.2	34.9	30.9	31.5	.42	2.07	.51	.65
April	46.5	48.9	44.1	40.7	1.12	.20	1.39	1.31
May	58.0	55.5	52.9	53.6	1.00	2.66	4.87	2.67
June	60.9	66.3	62.4	62.2	3.86	1.58	3.98	2.85

POPULATION TREND

South Study Area

Table 3 lists early winter classifications of mule deer on the south study area from 1960-71 through 1977-78. Table 4 lists classifications during fall, winter and spring of 1975-76 through 1977-78. Calculations involved in population estimates by Mackie (1976) are shown in Table 5; while Figure 2 extends Mackie's (1976) population trend estimates through 1977-78. These data show population declines from 1960 to 1961, 1964 to 1965 and 1971 through 1976. Population recovery generally started within two years following the first two declines. In contrast, during the 6 years since the population decline which occurred during winter 1971-72, the population has not recovered but rather continued to decline or remain relatively stable at a low level, at least through the winter of 1976-77. Low fawn/female and fawn/adult ratios have been associated with the recent low population level.

The severe winter of 1977-78 had much less impact on the deer population than expected. Although some winter mortality of fawns occurred, the fawn/adult ratio in spring was about the same as observed following the mild 1976-77 winter and considerably higher than that observed during the mild 1975-76 winter (Table 4). Winter mortality of adults was apparently low also. A minimum of 18 (95%) of 19 marked adults survived the winter. Because of the difficulty in observing animals marked only with neckbands, the remaining animal unaccounted for, could also be alive.

This phenomenon of low mortality during an extremely severe winter will be covered in greater detail in the discussion section.

Other "Breaks" Areas

Table 6 lists early winter population data for mule deer on the north study area from 1973-74 through 1977-78. Table 7 lists classifications during fall, winter and spring for 1975-76 through 1977-78. No comparative figures are available for years prior to 1973. This study area apparently suffered a greater decline in mule deer numbers during the 1975-76 winter than did the south study area. Data suggest that in recent years the north study area has had as low or lower recruitment of fawns than the south study area (Table 7). Information collected in the "Breaks" type to the east and west of the south study area (B. Watts and K. Constan personal communication) indicates that in recent years mule deer recruitment has also been very low in these areas. This would indicate that the population trend observed on our primary study areas apparently is representative of much of the river breaks complex in eastern Montana.

FAWN PRODUCTION AND SURVIVAL

Table 8 lists the known ratio of fawns/100 producing females and estimates the ratio of fawns/100 females for the population as a whole in June and mid-July 1976, 1977 and 1978. The estimate of fawns/100 pro-

Table 3. Sex and age composition of mule deer population on the Missouri Breaks Study Area, 1960-61 through 1977-78. Data were derived as aerial or ground classifications during December or early January of each year except 1969-70 and 1972-73, when classifications were completed during February and March, respectively.

Year	Type of Observation	Number Classified	Percentage			Ratios			% of Yrlg Males	
			Males	Female	Fawns	Males: 100 FF	Fawns: 100 FF	Fawns: 100 AD	Obsv.	Harv.
1960-61	Ground[1]	668	9.3	48.6	42.1	19.1	86.4	72.6	56	46
1961-62	Ground	430	15.5	60.7	24.0	25.3	39.5	31.5	74	47
1962-63	Ground	190	19.5	52.1	28.4	37.5	54.5	39.7	63	34
1963-64	Aerial[2]	362	16.0	45.6	38.4	35.1	84.2	63.3	47	36
1964-65	Aerial	611	22.7	47.8	29.5	47.6	61.6	41.7	47	43
1965-66	Aerial	434	21.4	58.1	20.5	36.9	35.3	25.8	33	13
1966-67	Aerial	289	17.3	52.6	30.1	32.9	57.2	43.1	46	
1967-68	Aerial[3]	115	20.0	40.0	40.0	50.0	100.0	66.7	--	
1968-69	None	-	-	-	-	-	-	-	--	
1969-70	Aerial	110	-	-	39.1	-	-	64.2	--	
1970-71	Aerial	776	18.8	48.1	33.1	39.1	68.9	49.5	47	
1971-72	Aerial	679	19.0	53.8	27.2	26.1	50.6	37.4	46	
1972-73	Aerial	235	-	-	19.1	-	-	23.7	--	
1973-74	Aerial	370	24.1	49.5	26.5	48.6	53.6	36.0	43	
1974-75	Aerial	315	25.6	55.1	19.3	46.0	35.1	24.0	50	
1975-76	Aerial	323	15.5	57.6	26.9	26.9	46.8	36.9	28	
1976-77	Aerial	258	17.4	57.4	25.2	30.4	43.9	33.6	40	
1977-78	Aerial	322	10.9	58.7	30.4	18.5	51.9	43.8	48	

[1] Cumulative observations on area during December.
[2] All aerial observations by helicopter except 1969-70 (fixed wing aircraft).
[3] Only west half of area surveyed in 1967-68.

Table 4. Classifications and observed recruitment of fawns on the south side Missouri Breaks study area, 1975-76, 1976-77 and 1977-78.

Date	Total Numbers	Adults	Young	Females	Males	Uncl.	Fawns/ 100 Adults	Fawns/ 100 FF
Sept.-Oct. 1975	105	69	36	50	19	-	52	72
December 1975	323	236	87	186	50	-	37	47
March 1976	193	173	19	--	--	-	11	--
October 1976	159	110	49	79	31	-	45	62
December 1976	258	193	65	148	45	-	34	44
March 1977	293	225	68	--	--	-	30	--
October 1977	112	70	41	51	20	-	59	80
December 1977	322	224	98	189	35	-	44	52
March 1978	255	195	51	--	--	9	26	--

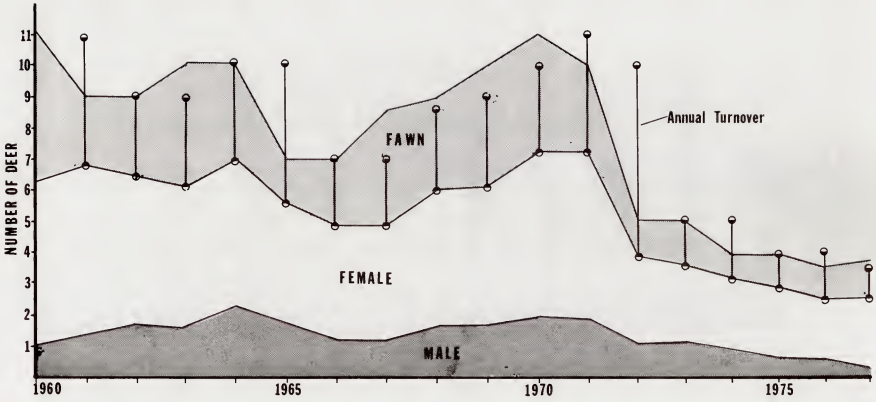


Figure 2. Population trend of mule deer on the Missouri Breaks Study Area, 1960-1977.

Table 5. Calculated population size, composition, and turnover on the Missouri River Breaks Study Area, 1960-61 through 1975-76. Data are for early winter of each year.

Year	Total Number	Number				Percent Males	Percent Fawn
		Male	Female	Fawn	1-1/2 Male		
1960-61	1,100	102	535	463	47(46%)	9.3	42.1
		232	231				
		334	766				
	Turnover = -196(58.9%)		-220(28.7%) = -416 (37.8%)				
1961-62	900	138	546	216	65(47%)	15.5	24.0
		108	108		28% Surv.		
		246	656		from 1960		
	Turnover = - 71(28.8%)		-185(28.3%) = - 256 (28.4%)				
1962-63	900	175	469	256	60(34%)	19.5	28.4
		128	128		55.6% Surv.		
		303	597		from 1961		
	Turnover = -143(47.2%)		-141(23.6%) = - 284 (31.5%)				
1963-64	1,000	160	456	384	75(47%)	16.0	38.4
		192	192		58.5% Surv.		
		352	648		from 1962		
	Turnover = -125(35.5%)		-170(26.2%) = -295 (29.5%)				
1964-65	1,000	227	478	295	107(47%)	22.7	29.5
		148	147		55.5% Surv.		
		375	625		from 1963		
	Turnover = -225(60.0%)		-218(34.8%) = -443 (44.3%)				
1965-66	700	150	407	143	50(33%)	21.4	20.5
		72	71		33.8% Surv.		
		222	478		from 1964		
	Turnover = -101(45.5%)		-110(23.0%) = -211(30.1%)				
1966-67	700	121	368	211	56(46%)	17.3	30.1
		106	105		78% Surv.		
		227	473		from 1965		
	Turnover = -107(47.1%)		-108(22.8%) = -215 (30.7%)				
1967-68	850*	120	365	365	56(47%)	20.0	40.0
		193	182		52.8% Surv.		
		303	547		from 1966		
	Turnover = -137(45.2%)		-113(20.7%) = -250 (29.4%)				
1968-69	900*	166	434	300		18.4	33.3
		150	150				
		316	584				
	Turnover = -148(46.8%)		-133(22.8%) = -281 (31.2%)				
1969-70	1,000*	168	451	391		16.8	39.1
		196	195				
		364	646				
	Turnover = -166(45.6%)		-118(18.3%) = -284 (28.4%)				

Table 5. Continued.

Year	Total Number	Number				Percent Males	Percent Fawn
		Male	Female	Fawn	1-1/2 Male		
1970-	1,100	198	528	363	93(47%)	18.8	33.1
71		182	181		47.4% Surv.		
		380	709		from 1969		
	Turnover = -190(50%)		-171(24.1%) = -361 (32.8%)				
1971-	1,000	190	538	272	87(46%)	19.0	27.2
72		136	136		41.2% Surv.		
		326	674		from 1970		
	Turnover = -208(63.8%)		-388(57.6%)** = -596 (59.6%)				
1972-	500	118	286	96		24.0	19.1
73		48	48				
	Turnover = - 46(27.7%)		- 86(25.7%) + -132 (26.4%)				
1973-	500	120	248	132	48(40%)	24.1	26.5
74		66	66		100% Surv.		
		186	314		from 1972		
	Turnover = - 83(44.6%)		- 94(29.9%) = -177 (35.4%)				
1974-	400	103	220	77	51(50%)	25.6	19.3
75		39	38		87.9% Surv.		
		142	258		from 1973		
	Turnover = - 80(56.3%)		- 28(10.9%) = -108 (27%)				
1975-	400	62	230	108	17(28%)	15.5	26.9
76					43.6% Surv.		
	Turnover = -55(47.4%)		-93(32.7%) = -148(37.0%)				
1976-	350	61	191	98	24(40%)	17.4	25.2
77		49	49		55.5% Surv.		
		110	240		from 1975		
	Turnover = -69(62.7%)		-20(8.3%) = -89(25.4%)				
1977-	375	41	220	114	20(48.4%)	10.9	30.4
78		57	57		40.8% Surv.		
		98	277		from 1976		

*Calculated based on mean turnover of 47 percent males, 23 percent females, plus observed age ratios, except 1968-69.

**Overwinter losses calculated from change in age ratio January to April as 83 percent fawns and 31 percent adults.

Table 6. December population summaries for mule deer on the north study area, NCRCA[1].

Year	Total	Adults	Fawns	Females	Males	Yearlings	Mature	Fawns/100 Females	Fawns/100 Adults
Pastures 3 and 4									
1973	184	134	50	100	34	18	16	50	37
1974	201	144	57	104	40	17	22	55	40
1975	208	172	36	119	53	19	34	30	21
1976	88[2]	63	25	42	11	1	6	60	40
1977	122	90	32	63	27	12	15	51	36

[1]Nichols Coulee Resource Conservation Area.

[2]Total count not obtained in comparable manner to other years.

Table 7. Classifications and observed recruitment of fawns on the north side Missouri Breaks study area, 1975-76, 1976-77 and 1977-78.

Date	Total No.	Adults	Young	Females	Males	Fawns/ 100 Adults	Fawns/100 Females
Sept.-Oct. 1975	84	62	22	36	26	36	61
December 1975	208	172	36	119	53	21	30
March 1976	115	109	6	--	--	5.5	--
Sept.-Oct. 1976	65	48	17	29	19	35	59
December 1976	88	63	25	52	11	40	48
March 1977	118	92	26	--	--	28	--
October 1977	47	28	19	17	11	68	112
December 1977	122	90	32	63	27	36	51
March 1978	76	68	8	--	--	12	--

ducing females was obtained from fawns observed with females during fawn capture and marking in June and from those observed during aerial flights and ground observations in mid-July. The ratios for June are minimum estimates since some fawn mortality was known to have occurred during June in all three years. Also, information from radioed fawns indicates that, occasionally, litters have been classified as singles when they were actually twins. The technique used in determining the percentage of producing females was discussed previously (Hamlin 1977a). The ratio of fawns/producing females in mid-to-late June was substantially higher in 1978 than the two prior years (Table 8). This higher ratio probably indicates a higher survival of fawns during the first few weeks of life rather than higher in utero production of fawns.

Table 8. Estimated mule deer fawn/female ratios in June and mid-July 1976, 1977, and 1978 on the south Missouri River Breaks study area.

	Fawns/100 Producing Females		Percent Females Producing		Estimated Population Fawn/Doe Ratio
June 1976	150:100 (14)[1]	x	94[2]	=	141:100
July 1976	131:100 (16)	x	71[3]	=	94:100
June 1977	152:100 (27)	x	82[3]	=	125:100
July 1977	140:100 (20)	x	76[3]	=	106:100
June 1978	165:100 (26)	x	90[3]	=	148:100
July 1978	142:100 (31)	x	83[3]	=	118:100

[1]Female sample size in parenthesis.

[2]Percent of female population older than yearling.

[3]Percent of females observed alone or with fawns.

The ratios of fawns/producing females observed on the study area in June are equal to or only slightly lower than in utero ratios of fetuses/pregnant females reported for other mule deer ranges (Hamlin 1977a). Considering the fact that these fawn at side ratios are obtained during a period of mortality, the data indicate that female mule deer on the south side study area are initially near maximum productivity.

Tables 9 and 10 show estimated and observed fawn/producing female ratios and mortality rates for the south and north study areas, respectively during the period June 1975 to March 1978. June ratios are estimated for the north study area in all years and for the south study area during 1975. The percent total fawn mortality may be somewhat underestimated since the June ratio is survival to that point rather than the ratio at birth. Both areas show approximately the same pattern of mortality between years, with 1976-77 having the lowest total mortality of the three years. The north study area has had higher total mortality than the south study area in all three years. Summer mortality was considerably less during 1977 than during the previous two summer.

Data in Tables 9 and 10 also indicate that fall and winter fawn mortality has often been equal to or greater than summer mortality on these study areas. The importance of this fall and winter mortality is indicated by Table 11. Fawn mortality is compared for three population situations. During 1975-77, the Breaks population trend was slightly declining to relatively stable at a low density with essentially no important hunting mortality. The Breaks population during 1960-64 was relatively stable at a high density with fairly heavy hunting mortality. Comparatively, a mule deer population at a low density on the Terry area in eastern Montana increased during 1975-77 with essentially no important hunting mortality (Hamlin 1978). It is interesting to note that the average fawn/female ratio during fall was essentially the same for all three population situations, indicating summer fawn mortality of approximately the same magnitude. The difference in the population level and performance in the three situations is reflected by the difference in fall and winter fawn mortality. Thus, fall and winter fawn mortality apparently has had the greatest impact on population level and trend.

CAUSES OF MULE DEER MORTALITY

In an attempt to determine causes of summer fawn mortality, a graduate research project was initiated in June 1976. Eleven, 19 and 16 fawns were monitored using radio telemetry during summer 1976, 1977 and 1978 respectively. Dood (1978) found 36 and 32 percent fawn mortality during summer 1976 and 1977 respectively. Coyote predation was the confirmed or probable proximate cause of death in all of the 1976 summer mortality of radioed fawns and in 67 percent of the 1977 summer mortality of radioed fawns. During summer 1978, one fawn apparently died due to abandonment and one was an apparent victim of coyote predation. Discounting the abandoned fawn, which may have been affected by its capture, only 1 (7 percent) of the radioed fawns died during summer 1978 (S. Riley personal communication). A total of 46 fawns were monitored during 3 summers; there were 12 deaths or 26 percent mortality. No

Table 9. Fawn production and survival on the south Missouri Breaks Study Area, 1975-76 through 1977-78.

	Fawns Per 100 Initially Producing Females	Approximate Mortality Rate	Percent Total Fawn Mortality	Total Fawn Mortality
1975-76				
Mid-June	150			
		--	--	
Mid-July	--			
		--	--	
October	83			
		35	22	
December	54			
		70	28	
March	16			
				89%
1976-77				
Mid-June	150			
		33	45	
Mid-July	101			
		34	31	
October	67			
		30	19	
December	47			
		11	5	
March	42			
				72%
1977-78				
Mid-June	152			
		15	20	
Mid-July	129			
		24	27	
October	98			
		36	31	
December	63			
		40	22	
March	38			
				75%

Table 10. Fawn production and survival on the north Missouri River Breaks Study Area, 1975-76 through 1977-78.

	Fawns Per 100 Initially Producing Females	Approximate Mortality Rate	Percent Total Fawn Mortality	Total Fawn Mortality
1975-76				
June	150			
		52	56	
October	72			
		51	26	
December	35			
		71	18	
March	10			
				93 %
1976-77				
June	150			
		59	77	
October	61			
		18	10	
December	50			
		30	13	
March	35			
				77 %
1977-78				
June	150			
		17	20	
October	124			
		52	49	
December	60			
		67	31	
March	20			
				87 %

Table 11. Comparative fawn/female, fawn/adult ratios and percent mortality for mule deer during fall-winter and winter-spring in the Missouri River Breaks 1975-77, 1960-64 and the Terry study area 1975-77.

	Missouri Breaks 1975-77	% Mort.	Missouri Breaks 1960-64	% Mort.	Terry Study Area 1975-77	% Mort.
Fall fawns/100 females	71.3	33	72.7	9	70.3	12
Winter fawns/100 females	47.7		66.2		16.7	
Winter fawns/100 adults	38.3	42	52.0	10	49.3	5
Spring fawns/100 adults	22.2		47.0		46.7	

fawn that died exhibited signs of poor condition prior to its death. Nine of the 12 deaths were coyote caused or probable coyote caused, 1 death was due to an accident, 1 death was due to abandonment, possibly related to capture, and 1 death was of unknown cause. Little is known of possible early mortality of fawns due to nutritive failure, however analysis of hair sample from fawns marked during 1976 and 1977 gave no evidence of an in utero protein deficiency (Dood 1978).

As discussed in the section of fawn production and survival, much of the important fawn mortality occurs from October through March. Little is known about causes of this mortality. Radio transmitters with longer battery life were put on fawns during summer 1977 with the hope of obtaining information throughout the fall. Unfortunately, the transmitters quit at varied intervals throughout the fall and no reliable sample of mortality could be obtained. One radioed fawn was known to have died during October, but the cause of death was undetermined.

Known mortality of deer during fall and winter has been confined to hunting mortality on males and coyote predation on all sex and age classes. One radio collared adult female was known to have been illegally shot during September 1977. Probable coyote-killed deer found during winter are listed in Table 12. Knowles (1976) documented substantial mortality of deer due to coyote predation during winter 1975-76. Table 12 indicates that fewer coyote-killed deer have been found during the last two winters than during 1975-76 in spite of more time and effort expended recently in attempts to locate carcasses. Knowles (1976) indicated that coyotes were often able to gain a competitive advantage on deer by using topographic features and/or meteorological conditions. He also noted that femur marrows of many of the coyote-killed deer indicated that the deer were in good to average condition. These same things have been noted in recent years. Marrows of three coyote-killed deer found in the last two years were analyzed for fat content (Verme

Table 12. Probable coyote-killed deer found during winter (December-March).

	Uplands	Bottomlands	River Ice	Reservoir Ice	TOTAL
Mule Deer					
1975-76	9	2	1	33	45
1976-77	4	0	3	9	16
1977-78	5	0	2	1	8
White-tailed Deer					
1975-76	1	10	9	0	20
1976-77	0	1	3	0	4
1977-78	0	1	0	0	1

and Holland 1973). Two marrow samples which appeared to be white and firm, contained 90 and 72 percent fat. One marrow which was yellowish and softer contained 43 percent fat. The extent and population consequences of fall-winter coyote predation remains unknown at this time.

An overview of hunting mortality on this area was presented in last year's report (Hamlin 1977a). Table 13 contains known harvest statistics to date. Hunting mortality should have been of negligible population consequence during the last three years since only adult males could legally be harvested. During this period of restrictive hunting seasons, the mule deer population has declined, or at best, remained stable in some years. Particularly noticeable is the fact that despite no hunting mortality of females and fawns during the last three years, the female segment of the population has at best remained stable (Table 5 and Figure 2). The observed low level of recruitment of fawns has not been enough to keep pace with the overall mortality rate of mule deer in this area.

New techniques and increased effort will be necessary to determine causes of fall-winter fawn mortality.

PHYSICAL CONDITION

In an effort to determine if nutritional deficiencies are related to the population decline, physical condition of the herd was evaluated. Studies by French et al. (1956) and Robinette et al. (1973) have both shown that improved nutrition in deer results in increased antler size. Antler development, especially in the yearling age class, may be a sensitive indicator of nutritional level since body growth takes a precedence over antler de-

Table 13. Mule deer harvest statistics for HD 410 and the south side research area.[1]

Year	Mule Deer Bag Limit	HD 410[2] Harvest	Hunters	Min. known kill on research area	Open. day check sta. HD 410[2] Number Hunters	Kill
1959	2-ES	5,117	5,084			
1960	2-ES	5,769	6,486	150	407	129
1961	2-ES	5,951	7,091	151	224	70
1962	2-ES	5,964	6,482	81	350	70
1963	2-ES	6,683	5,925	37	89	37
1964	2-ES	6,800	6,860	73	117	55
1965	2-ES	2,945	3,680		141	26
1966	2-ES	4,086	4,468			
1967	2-ES	2,603	3,587			
1968	2-ES	3,061	4,031			
1969	2-ES	3,102	3,399			
1970	2-ES	3,271	3,774			
1971	2-ES	4,245	7,351			
1972	2-ES	3,050	7,385			
1973	1-ES	1,689	5,847			
1974	1-ES	1,531	5,614			
1975	1-MM only	890	5,560			
1976	1-MM only	738	2,742	7	48	4
1977	1-MM only	726	2,444	21	73	5

[1] Point estimates for harvest from statewide hunter questionnaire.
[2] Data are for pre-1973 hunting district. HD 410 = present 410 + HD 417

velopment (French et al. 1956). Table 14 and 15 compare antler development between the 1960-64 period of high population density, high hunting pressure and high fawn survival to the 1974-77 period of low population density, low hunting pressure and low fawn survival. Data in these tables seem to indicate that the deer in recent years have had at least as good and probably a better nutritional regime than the deer during the 1960-64 period. Small sample size in recent years appears to be the major reason that statistically significant differences are not more apparent. Although the results are not conclusive, these data seem to indicate that nutritional deficiencies are not a major reason for the poor population performance in recent years.

Table 14. Antler classes of mule deer yearling males from the south side Missouri Breaks during the 1960-64 and 1973-77 periods from check station and post-season classifications combined.

Year	Spike	2 - Point	Total Yearling Males
1960	32 (34)[1]	63 (66)	95
1961*	56 (50)	55 (50)	111
1962	14 (19)	60 (81)	74
1963	14 (21)	52 (79)	66
1964	33 (33)	68 (67)	101
1960-64+	149 (33)	298 (67)	447
1973	13 (30)	30 (70)	43
1974	7 (18)	32 (82)	39
1975	5 (36)	9 (64)	14
1976	5 (19)	22 (81)	27
1977	5 (22)	18 (78)	23
1973-77+	35 (24)	111 (76)	146

[1] Number (Percent)
*Significant difference, X^2, $P < .05$, from all other individual years.
+1960-64 period significantly different, $X^2 = 4.08$, weighted $X^2 = 4.75$, $P < .05$, from 1973-77 period.

Table 15. Average antler beam diameters one inch above burr for yearling male mule deer on the south side Missouri Breaks area, 1960-64 and 1976-77.

Year	Average beam diameter (mm.)	Years of significant[3] difference (P <.01)
1960	16.9 (48)[1]	1961, 1963
1961	15.2 (47)	1960, 1963, 1964, 1976[2], 1977
1962	16.6 (14)	none
1963	18.9 (21)	1960, 1961, 1964
1964	17.2 (54)	1961, 1963
1976	17.5 (6)	1961
1977	18.1 (8)	1961

[1]Sample size in parenthesis.
[2]Significant only at .05 level.
[3]T - test of means of independent samples of unequal sizes.

Femur marrow samples from two adult female mule deer trap casualties in late March 1977 were examined. Although 1976-77 was a relatively mild winter (Table 1), late March should have been near a low point in their physical conditon cycle. Femur marrow samples of the two deer indicated 96 and 94 percent fat content.

FORAGE PRODUCTION

Management of animal populations to maintain them within the "carrying capacity" of the range has often been a stated objective of various management agencies. A search of available literature soon indicates that this objective is unrealistic, at least in an even vaguely precise manner. Units of land can have broadly defined "carrying capacities," but relatively precise management is impractical. Work on vegetation production by Blaisdell (1958), Mueggler (1972) and Cable (1975) indicate that forage production by grasses, forbs and shrubs can vary from 2-3 fold among individual years on the same site. This does not say that deer or other animals do not respond to yearly changes in "carrying capacity", but that management for these changes is impractical.

In an effort to determine if deer in the Missouri River Breaks respond to yearly changes in forage production, correlations were made between December fawn/female ratios and estimators of vegetation production (Table 16). Blaisdell (1958) working in somewhat similar climatic conditions found that July-March precipitation prior to the growing season and April-May temperature during the growing season were highly correlated with total forage production of grasses and forbs. Correlations of forage and production with weather data have not been made for the Missouri Breaks study area at this time. Since growing seasons are approximately the same on the Missouri Breaks study area as Blaisdell's area, I used the interrelationships of July-March precipitation and April-May temperature as an estimator of forage production.

Table 16. Multiple and partial correlation coefficients of December fawn/doe ratios during various periods with July-March precipitation and April-May mean temperature prior to birth of fawns.

Time Period	(Number) (of) (years)	Multiple Correlation Coefficients	Partial Correlation Coefficients: Precipitation (Temperature) (effect removed)	Partial Correlation Coefficients: Temperature (Precipitation) (effect removed)
1960-1977	(12)	.127	.066	-.349
1960-1971	(8)	.842**	.856**	-.889**
1974-1977	(4)	.298	.438	.399

**
Significant at .01 level.

During the years prior to the recent population crash (1960-71) a very highly significant correlation existed between fawn survival to December estimates of forage production (Table 16). The multiple correlation coefficient indicated that 84 percent of the variation in December fawn/female ratios was explained by the interaction of the two estimates of vegetation production. In the years since the population decline (1974-1977), the correlations are not high and are not significant. Combining the data for all years (1960-1977), indicates that not only have correlations been low in recent years (1974-1977), but they may indicate an opposite trend from 1960-1971 since they substantially lower the overall correlation.

These data and correlation coefficients suggest that during 1960-1971 forage production was highly correlated with fawn survival but that in the years since the population decline, factors other than forage

production have been more important in determining fawn survival. From the standpoint of deer density alone this phenomenon is to be expected. The yearly level of forage production would be expected to be more critical to deer survival at high deer densities (1960-1971) than at low deer densities (1972-1977). Although the level of forage production still affects the deer herd, some other factor or factors may be having greater influence on deer health and survival at the present time.

Other work being done on forage production includes documentation of the difference of forage abundance and production between years and habitat types. This work will be reported in future reports. Related studies concerning production on this area are being conducted by Jorgensen (1977, 1978) and are reported separately.

FOOD HABITS

Considerable prior work on food habits of mule deer, elk and cattle has been done in this area and was reported by Mackie (1970) and Knowles (1975).

Fall-winter food habits information for 1976-77 and 1977-78 obtained from rumen samples are presented in Table 17. Deer made considerable use of grasses, primarily Sandberg bluegrass, Poa sandbergii, during the fall green-up in 1977. Mackie (1970) also noted considerable use of Sandberg bluegrass when fall green-up occurred. Coinciding with this increased use of green grasses, the fall use of browse declined in relation to 1976. The major species of browse used remained the same. Recent food habits information indicates that generally more rabbitbrush (Chrysothamnus spp.) and snowberry (Symphorocarpos spp.) and less big sagebrush (Artemisia tridentata) are being used during the fall-winter period now than during the 1960-64 period. This may relate to the fact that there are only one-third as many deer present now compared to the 1960-64 period. Much of the snowberry being used consisted of berries. These berries are apparently high quality, high energy forage. Forage used during winter 1977-78 probably reflects the extreme snow depth and limited forage availability rather than the preferences of deer.

MOVEMENTS

Table 18 lists minimum home range sizes for mule deer on the study area. Mule deer occupy yearlong home ranges on this area rather than being migratory. They may, however, use certain portions of their home range more intensively at certain times of the year and under certain conditions. Minimum home ranges for females followed for one year or more ranged from 1170 acres to 2505 acres and averaged 1720 acres. The home range of one male was 5360 acres and the home range of a stag was 4320 acres. The home range of the stag may be equivalent to that of a normal male, since he, like other males, does not belong to a relatively stable social group as do females.

TABLE 17. Fall-winter food habits of mule deer on the south side Missouri River Breaks, 1976-77 and 1977-78.

Taxa	FALL		WINTER	
	1976 (2)[1]	1977 (11)	1976-77 (9)	1977-78 (5)
GRASSES	tr.[2]/50	37/100[3]	tr./44	------
FORBS				
Artemisia longifolia	------	------	8/44	------
Chrysopsis villosa	------	tr./27	------	------
Compositae	------	------	tr./11	------
Medicago sativa	------	1/9	------	------
Melilotus officionalis	------	tr./9	tr./11	------
Phlox hoodii	------	tr./9	------	------
Yucca glauca	tr./50	------	------	------
Unid. Forbs	10/100	1/45	tr./22	1/20
Total Forbs	10/100	3/64	9/44	1/20
BROWSE				
Artemisia tridentata	------	------	13/89	19/100
Atriplex nutalli	------	------	4/44	11/40
Chrysothamnus spp.	67/100	20/82	37/100	7/20
Juniperus scopulorum	tr./50	2/36	18/100	17/100
Pinus ponderosa	tr./100	------	------	33/100
Pseudotsuga menziesii	tr./50	------	tr./11	------
Rhus trilobata	tr./50	------	8/78	12/80
Rosa spp.	8/100	1/82	tr./33	------
Salix spp.	tr./50	------	------	------
Symphorocarpos spp.	19/100	37/100	11/100	------
Unid Browse	------	------	tr./38	------
Total Browse	90/100	60/100	91/100	99/100
OTHER				
Fungi	------	tr./18	------	------

[1] No. of rumens

[2] tr. = trace or less than 0.5 percent

[3] percent of diet by volume/percent frequency of occurrence.

Table 18. Minimum home range size of radio marked mule deer on the southside Missouri River Breaks study area.

Animal Number	Sex	Age at Capture	Number of Relocations	Length of Time Followed	Minimum Home Range	
					Acres	Miles^2
1-76	Stag	Mature	66	28 months	4320	6.75
2-76	Female	Mature	38	28 months	2505	3.90
3-76	Female	Mature	92	27 months	1445	2.25
4-76	Female	Mature	27	9 months	900	1.40
5-76	Female	Mature	53	18 months	1455	2.25
6-76	Female	Mature	65	27 months	1170	1.83
7-76	Female	Mature	16	27 months	1255	1.96
1-77	Male	1½	29	17 months	5360	8.38
5-77	Female	Mature	45	17 months	1780	2.78
9-77	Female	Mature	49	16 months	1260	1.97
10-77	Female	Mature	40	16 months	2230	3.49
14-77	Female	Mature	50	15 months	2380	3.72
Average for females followed one year or longer.					1720	2.69

Not included in the calculated home range sizes are the areas the deer used during winter 1977-78. Almost all deer moved north toward the river from their normal home ranges and occupied areas with steep slopes having less snow depth. Mackie (1970) noted this same phenomenon during the severe winter of 1964-65.

Future reports will attempt to determine factors influencing home range size and use.

UNGULATE DISTRIBUTION AND COMPETITION

Figure 3 shows generalized deer distribution on the south study area during 1976-78 as compared to 1960-64. High, medium and low densities are not equivalent between the two period. Densities were probably

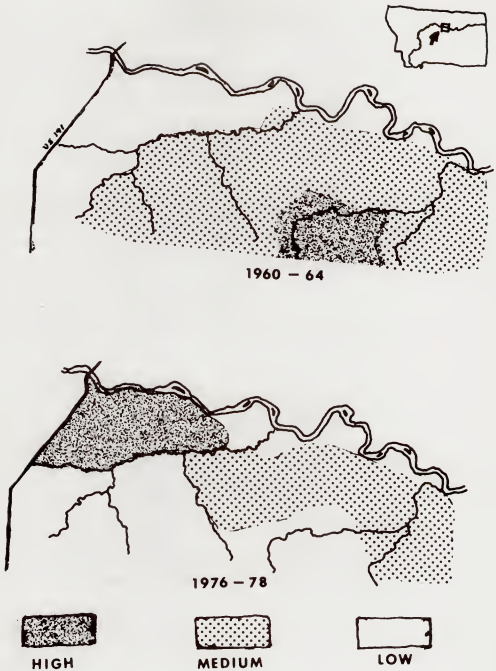


Figure 3. Generalized density distribution of mule deer on the south Missouri River Breaks study area 1960-64 and 1976-78.

higher "across the board" in 1960-64 than in 1976-78. As can be seen, the highest density area in 1960-64 is now one of the low density areas. This area was primarily used as a winter cattle pasture during 1960-64 but is now used intensively by cattle in spring and early summer. The high density area for mule deer now is one with low cattle densities (Figure 4).

Figure 4 shows generalized distributions of elk and cattle during late spring through fall. These distribitions are essentially the same as reported by Mackie (1970) for the 1960-64 period. Although these figures are highly generalized, they indicate some important areas where distributions of elk and cattle do not overlap, especially at the time each is using the area. More striking is the distribution of deer in relation to both elk and cattle. The high and medium density deer areas are those of least overlap with elk and cattle. These differences in density distributions will be further evaluated with respect to possible influence on mule deer dymanics in future studies.

With prevailing low deer densities on the area, less competition might be expected with cattle and elk than under higher deer densities which prevailed prior to 1971-72. Yet, the differences in density distributions between species and the apparent changes in mule deer density associated with changes in livestock grazing would indicate that competition should be further evaluated as a possible factor in the deer decline and/or in the failure of deer numbers to recover following the decline. Past evaluations of competition in this area (Mackie 1970, Knowles 1975, Komberec 1976), like most studies of interspecific relations, were concerned mainly with overlap in food habits and range use. It now seems likely that these parameters may be poor or incomplete measures which can be misleading with respect to the actual occurrence of competition on an area (Mackie 1978). Animals such as elk may not only compete for forage with cattle; but may have a social aversion for cattle as well (Lonner 1976, Campbell and Knowles in press). Any competition with elk by cattle may cause the elk to compete more with deer than previously. Forage may be lost to trampling by cattle; Quinn and Hervey (1970) estimated trampling loss at 1-5%, while Laycock et al. (1972) estimated trampling loss at 17-23 percent. Pearson (1975) reported that direct forage consumption accounted for only 36 to 47 percent of the total herbage removed or lost where cattle were grazed. Forage competition among different ungulates is often dismissed because percent diet overlap is often only 1-10 percent. This may also require re-evaluation. Summer forage requirements for lactating domestic cows are estimated at 28 pounds air dried forage per day and deer at 4.5 pounds air dried forage per day (Halls 1970). Summer forage requirements for elk are estimated at 15 pounds air dry forage per day (Floyd Blunt, Wyoming Game and Fish Department, Sybille Research Station, personal communication). This means that items making up 5 percent of a cows daily diet would be equal in volume to 31 percent of a deer's daily diet and 10 percent of a cows diet would be 62 percent of the deer's daily requirement. Items comprising five percent and 10 percent of an elks daily diet would contribute 17 percent and 33 percent, respectively, to the daily diet of a deer. This interpretation indicates that minor items in the diet of cattle and elk may actually represent significant forage competition with deer. Moreover, even minor forage may contribute significantly to dietary requirements of deer as suggested by Mackie (1976).

ELK

CATTLE

Figure 4. General distribution of highest densities (stippled areas) for elk from May-September and cattle from April-November on the south study area.

DISCUSSION

Winter Weather and Effects on Deer

In recent times, severe winters have occurred in 1964-65, 1968-69, 1971-72 and 1977-78. Population estimates indicated that deer mortality was high during winter 1964-65 and 1971-72, but relatively low in 1968-69 and 1977-78. The unexpected high deer survival during the extremely severe winter of 1977-78 and subsequent excellent fawn crop during summer 1978 (Table 8) prompted a review of the effects of severe winters on deer.

Recent reports by Mautz et al. (1976), Short et al (1974), Walmo et al. (1977) and Hamlin (1977b) indicate that forage quality and quantity during winter is insufficient by itselt to support a northern deer herd at any population level. Studies by Wood et al. (1962), Silver et al. (1969) and Thompson et al. (1973) show that deer voluntarily reduce food intake and show a distinct weight loss during winter even when provided with a good quality forage ad libitum. Deer have a lowered basal metabolic rate and a highly insulative coat of hair during winter (Silver et al 1969). Behavioral adaptations in activity and range use also reduce winter stress on deer.

This information about the forage quantity and quality of the traditional winter range and the winter survival adaptations of deer indicate that a very important component of winter range is the fat reserves accumulated by deer during summer and fall. Winter forage is important in that it helps slow down the rate at which fat reserves are used. The severity and length of the winter also determine the rate and extent of use of fat reserves. Different sex and age classes have different fat accumulation levels and carry different amounts of "winter range" into winter. Mautz (1978) gives a good summary of this concept.

Severe deer mortality occurred on the Missouri Breaks study area during winter 1964-65 and 1971-72. Both of these periods were during times of high deer densities and low to average forage production prior to the winter. Relatively low deer mortality occurred during the severe winters of 1968-69 and 1977-78. Deer density was high during 1968-69, but vegetation production was excellent during summer 1968. Deer density was low during 1977-78 and although summer forage production was average or below average, a fall "green-up" increased the quantity of and length of time that high quality forage was available.

Thus, summer and fall range quality and quantity are a very important component of "winter range". Intraspecific and interspecific competition and vegetation production all affect the summer-fall range quality and quantity and also affect the amount of winter forage available to slow down the rate of fat catabolism. The importance of summer range to deer production and survival has been previously noted by Julander et al. (1961) and Pederson and Harper (1978).

Population Decline and Lack of Resiliency

The initial population decline in 1971-72 appears to have been a result of the deer herd entering the severe winter without sufficient energy reserves to carry them through the winter. The effects of continued heavy either-sex hunting pressure on the mule deer population for several years after the severe winter cannot be ruled out as having contributed to a continuing population decline and/or lack of recovery. The lack of population recovery in the years subsequent to this is less understandable and is the basis for this research project.

When a population declines and then fails to recover, mortality is obviously exceeding and/or equaling natality. A first step in determining the basis of this problem is to determine if natality is excessively low or mortality is excessively high, or both. Information to date (Hamlin 1977a and this report) indicates that natality is near species potential, or at least "normal". Thus, mortality in the "Breaks" population must be excessive. Existing data indicate that excessive mortality of fawns has led to and still contributes to the present low deer population. In many cases, a cursory appraisal of weather conditions, forage, water, cover, disease, hunting and predation may implicate the factor or factors involved.

During most of the past six years, winter conditions and forage production conditions have, at least on a superficial examination, been excellent for deer survival (Tables 1 and 2). Shrub cover has not declined, and may have increased, and herbaceous cover, because of good growing conditions, has been good in most years. There has been no evidence of disease in the mule deer during this period. Although heavy either-sex hunting pressure immediately after the severe winter may have had population impacts, hunting pressure has been reduced since 1973, with no hunting of females or fawns after 1974 (Table 13). There are thirteen more waterholding reservoirs on the study area at present than during the 1960's; though lack of free water is not believed to be a problem (Mackie 1970). It is possible, however, these additional reservoirs have created a potential forage problem and contributed to increased competition with livestock. Almost all of the new reservoirs are within deer "habitat". The redistribution of more cattle into deer habitat and subsequent forage depletion around the reservoirs undoubtedly has had some impact on the deer. It is doubtful, however, that even if thirteen square miles of deer habitat were substantially reduced in value, that a deer density decline of the magnitude experienced would result. Predation by coyotes has been documented (Dood 1978) as the major source of mule deer fawn mortality during summer. However, in view of the data in Table 11 and the accompanying discussion, the level of fawn mortality experienced during summer should not be sufficient to keep the population from increasing. The additional fall-winter mortality of fawns thus appears to be the primary factor retarding population growth. While limited information has been obtained in relation to fall-winter coyote predation on mule deer, the extent of

our knowledge in this area to date is minimal. Increased knowledge about the ultimate causes of fall-winter fawn mortality is essential to our understanding of population dynamics in the Missouri River Breaks mule deer herd. Greater effort must be placed on documenting and evaluating factors affecting fawn survival from fall through winter.

LITERATURE CITED

Allen, E. O. 1968. Range use, foods, condition and productivity of white-tailed deer in Montana. J. Wildl. Manage. 32(1):130-141.

Blaisdell, J. P. 1958. Seasonal development and yield of native plants on the upper Snake river plains and their relation to certain climatic factors. Tech. Bull. No. 1190, U.S.D.A., Washington D. C. 68 pp.

Cable, D. R. 1975. Influence of precipitation on perennial grass production in the semidesert southwest. Ecology 56(4):981-986.

Dood, A. R. 1978. Summer movements, habitat use, and mortality of mule deer fawns in the Missouri River Breaks, Montana. Montana Job Compl. Rept., Proj. W-120-R-8,9. Job No. 9. 55 pp.

French, C. E., L. C. McEwan, N. D. Magruder, R. H. Ingram and R. W. Swift. 1956. Nutrient requirements for growth and antler development in the white-tailed deer. J. Wildl. Manage. 20(3): 221-232.

Halls, L. K. 1970. Nutrient requirements of livestock and game. In: Range and Wildlife Habitat Evaluation--A Research Symposium. U.S.D.A. Forest Service Misc. Publ. No. 1147. pp 10-18.

Hamlin, K. L. 1977a. Mule deer population ecology, habitat relationships, and relations to livestock grazing management and elk in the Missouri River Breaks, Montana. In: Montana Deer Studies. Job Progress Rept., Proj. W-120-R-8. Job 3. pp. 84-104.

_____. 1977b. Population dynamics and habitat relationships of mule deer in the Bridger Mountains, Montana, 1955-1976. A paper presented to the Northwest Section of the Wildlife Society, Kalispell, Montana. Feb. 1977. 13 pp.

_____. 1978. Population ecology and habitat relationships of mule deer and white-tailed deer in prairie-agricultural habitats of eastern Montana. In: Montana Deer Studies. Job Progress Rept., Proj. W-120-R-9. Job 4. pp. 83-113.

Jorgensen, H. E. 1977. Evaluation and development of range survey concepts, methods, and criteria. Mont. Dept. of Fish and Game. Job Prog. Rpt., Fed Aid Proj. W-120-R-8. pp 1-12.

_____. 1978. Evaluation of range survey methods, concepts and criteria. Mont. Dept. of Fish and Game. Job Prog. Rpt., Fed. Aid Proj. W-120-R-9, Study H-1.1, Job 1. 9pp.

Julander, O., W. L. Robinette, and D. A. Jones. 1961. Relation of summer range condition to mule deer herd productivity. J. Wildl. Manage. 25(1):54-60.

Knowles, C. J. 1975. Range relationships of mule deer, elk and cattle in a rest-rotation grazing system during summer and fall. M. S. Thesis, Mont. State Univ., Bozeman. 111 pp.

_____. 1976. Observations of coyote predation on mule deer and white-tailed deer in the Missouri River Breaks, 1975-76. In: Montana Deer Studies. Job. Prog. Rept., Proj. W-120-R-7. pp. 117-138.

Komberec, T. J. 1976. Range relationships of mule deer, elk and cattle in a rest-rotation grazing system during winter and spring. M. S. Thesis. Monta. State Univ., Bozeman. 79 pp.

Laycock, W. A., H. Buchanan and W. C. Kruger. 1972. Three methods of determining diet, utilization, and trampling damage on sheep ranges. J. Range. Manage. 25(5):352-356.

Lonner, T. N. 1976. Montana Cooperative Elk-logging study. Job II-B, Long Tom Creek Study. pp. 15-56.

Mackie, R. J. 1966. Some phenomena associated with dynamics of mule deer in the Missouri River Breaks of Montana. Proc. West. Assoc. St. Game Fish Comm. 46:129-133.

_____. 1970. Range ecology and relations of mule deer in the Missouri River Breaks, Montana. Wildl. Monogr. No. 20. 79 pp.

_____. 1973. What we've learned about our most popular game animal. Mont. Outdoors. 4(5):15-21.

_____. 1976. Mule deer population ecology, habitat relationships, and relations to livestock grazing management and elk in the Missouri River Breaks, Montana. In: Montana Deer Studies. Job. Compl. Rept., Proj. W-120-R-7. pp. 67-94.

_____. Impacts of livestock grazing on wild ungulates. A paper presented to the 43rd North American Wildlife and Natural Resources Conference, Phoenix, Arizona, March 18-22, 1978. 21 pp.

Mautz, W. W. 1978. Sledding on a bushy hillside: The fat cycle in deer. Wildl. Soc. Bull. 6(2):88-90.

_____, H. Silver, J. B. Holter, H. H. Hayes and W. E. Urban, Jr. 1976. Digestibility and related nutritional data for seven northern deer browse species. J. Wildl. Manage. 40(4):630-638.

Mueggler, W. F. 1972. Plant development and yield on mountain grasslands in southwestern Montana. U.S.D.A. Forest Service Research Paper INT-124. 20 pp.

Pearson, H. A. 1975. Herbage disappearance and grazing capacity determinations of southern pine bluestem range. J. Range Manage. 28(1):71-73.

Pederson, J. C. and K. T. Harper. 1978. Factors influencing productivity of two mule deer herds in Utah. J. Range Manage. 31(2): 105-110.

Picton, H. D. and R. R. Knight. 1969. A numerical index of winter conditions of use in big game management. Proc. symp. on snow and ice in relation to wildlife and recreation. Iowa State Univ., Ames. pp 29-38.

Quinn, J. A. and D. F. Hervey. 1970. Trampling losses and travel by cattle on Sandhills range. J. Range Manage. 23(1):50-54.

Robinette, W. E., C. H. Baer, R. E. Pillmore, and C. E. Knittle. 1973. Effects of nutritional change on captive mule deer. J. Wildl. Manage. 37(3):312-326.

Short, H. E., R. M. Blair and C. A. Segelquist. 1974. Fiber composition and forage digestibility by small ruminants. J. Wildl. Manage. 38(2):197-209.

Silver, H., N. F. Colovos, J. B. Holter, and H. H. Hayes. 1969. Fasting metabolism of white-tailed deer. J. Wildl. Manage. 33(3):490-498.

Thompson, C. B., J. B. Holter, H. H. Hayes, H. Silver, and W. E. Urban, Jr. 1973. Nutrition of white-tailed deer. I. Energy requirement of fawns. J. Wildl. Manage. 37(3):301-311.

Verme, L. J. and J. C. Holland. 1973. Reagent-dry assay of marrow fat in white-tailed deer. J. Wildl. Manage. 37(1):103-105.

Walmo, O. C., L. H. Carpenter, W. L. Regelin, R. B. Gill and D. L. Baker. 1977. Evaluation of deer habitat on a nutritional basis. J. Range Manage. 30(2):122-127.

Wood, A. J., I. M. Cowan, and H. C. Nordan. 1962. Periodicity of growth in ungulates as shown by deer of the genus Odocoileus. Canad. J. Zool. 40(4):593-603.

Submitted by: Kenneth L. Hamlin

JOB TITLE: Population ecology and habitat relationships of white-tailed deer on bottomlands of the Missouri River in northcentral Montana, 1977-78.

ABSTRACT:

Limited information was collected on a white-tailed deer population study on the Missouri River bottomlands of northcentral Montana. Twenty-four different white-tailed deer were captured and fitted with individually recognizable neck collars. Numbers of white-tailed deer observed during the early winter helicopter survey approximated those observed during 1975-76. Preliminary indications are that the low numbers of white-tailed deer observed during winter-spring 1976-77 were a result of white-tailed deer wintering in areas other than the river bottom rather than a reflection of a severe population decline. Severe flooding of all bottoms during March 1978 disrupted normal distribution and range use habits of white-tailed deer on the study area.

JOB TITLE: Population ecology and habitat relationships of white-tailed deer on bottomlands of the Missouri River in northcentral Montana, 1977-78.

JOB OBJECTIVE: To determine the environmental requirements of white-tailed deer and factors regulating whitetail population in major river bottom habitats of northcentral Montana.

To determine the effects of various potentially competing land use and management practices upon white-tailed deer in northcentral Montana.

To develop new and improved guidelines for management of northcentral Montana whitetail populations and their habitats.

INTRODUCTION:

Few data are available on the population ecology and environmental requirements of white-tailed deer (*Odocoileus virginiana*) populations associated with the floodplains of major rivers in Montana. The only existing study (Allen 1968) was conducted in 1964-65 and primarily concerned range use, food habits, condition and productivity of white-tailed deer on bottomlands of the Missouri River in northcentral Montana.

To meet the need for further information concerning white-tailed deer in river bottom habitats, this study was established during 1975 on the same area on which Allen's (1968) study was conducted. Field studies were initiated during early winter 1975-76 and preliminary findings have been reported by Mackie and Knowles (1976) and Hamlin (1977). Due to other work demands, field studies have not been intensive and were confined primarily to obtaining population data and deer distribution.

STUDY AREA

The study area is located on the Charles M. Russell Wildlife Refuge, administered by the U. S. Department of Interior Fish and Wildlife Service. The study area consisted of 20 bottoms and 3 islands included in a straight line distance of about 23 miles (Fig. 1). The floodplain varied from ½ to 1 mile in width and bottoms, ranging in size from 144 to 644 acres, usually alternated between north and south sides of the river. The ridges overlooking the river are at approximately 2,900 feet elevation and slope at a relatively steep angle to the floodplain at approximately 2,270 feet.

Physiography, climate, land usage and vegetation of this area have been described in detail by Allen (1968). Mackie (1970) and Knowles (1975) provide similar information for adjacent uplands.

Figure 1. Map of study area.

METHODS

Existing data from prior management surveys and research studies on white-tailed deer on Missouri River bottoms of the study area were reviewed, analyzed and incorporated into the present report when applicable.

An early winter, December 27, 1977, aerial survey, employing a helicopter, was conducted to count and classify whitetails on the study area.

During January and February, 24 different white-tailed deer were captured with Clover traps (Clover 1954) and with a cannon net (Mackie et al. 1975) on bottoms 4 and 7 (Fig. 1). Two were fitted with radio transmitters and 22 with individual observation collars of Armortite fabric.

Periodic ground and aerial (Piper Supercub) observations were made throughout the year to determine movements, distribution, mortality and survival of white-tailed deer.

RESULTS

Population

Table 1 shows numbers and sex and age composition of white-tailed deer during the early winter helicopter survey of the study area in relation to data for previous years. The total of 110 white-tailed deer appeared to be a relatively accurate estimate of numbers of whitetails present. During subsequent Supercub surveys on 1-20, 2-3 and 2-27-78, 90, 107 and 99 white-tailed deer, respectively, were observed. These figures are substantially more than the 18 whitetails observed during the December 1976 flight. Subsequent flights that winter and spring could only increase the population estimate to 46 whitetails. The number of deer counted during the 1977-78 flight is much greater than can be accounted for by adding surviving fawns to last year's population estimate. Numbers of deer observed during the

Table 1. White-tailed deer numbers, sex and age composition from early winter surveys 1960-1976.

Year	Numbers							Ratios				
	Tot.	AD	YG	Fem.	Males[1]	Yrlg	Mature	YG:100 AD	YG:100 FF	% YG	MM:100 FF	% YG MM
1960-61[2]	28	18	10	-	-	-	-	55.5	---	35.7	---	---
1961-62[3]	120	54	66	-	-	-	-	122.0	---	55.0	---	---
1962-63[4]	106	76	30	-	-	-	-	39.5	---	28.3	---	---
1964-65[5]	188	168	20	123	45	14	24	11.9	16.2	10.6	36.6	36.8
1965-66[6]	178	137	41	110	27	3	17	29.9	37.3	23.0	24.5	15.0
1966-67[7]	223	162	61	121	41	10	29	37.6	50.4	27.3	33.9	25.6
1971-72[8]	267	182	60	139	43	-	-	33.0	43.2	22.5	30.1	---
1973-74[9]	207	168	39	146	22	9	13	23.2	26.7	18.8	15.1	40.9
1975-76[10]	121	105	16	76	29	8	21	15.2	21.0	13.2	38.2	27.6
1976-77[11]	18	15	3	10	5	2	3	20.0	30.0	16.6	50.0	66.7
1977-78[12]	110	96	14	58	38	17	21	14.6	24.1	12.7	65.5	44.7

[1] Includes unclassified males.
[2] Sample classified ground late November - early January.
[3] Sample classified ground January 8 - January 12, 1963.
[4] Sample classified ground late November - early January.
[5] Helicopter survey December 29 and 30, 1964. Complete coverage also includes Grand Island.
[6] Helicopter survey December 30 and 31, 1965. Incomplete, Middle and Lower Units only.
[7] Helicopter survey December 19, 22 and 23, 1966. Incomplete, Middle and Lower Units only.
[8] Helicopter survey December 29, 1971. Complete.
[9] Helicopter survey January 1, 1974. Complete.
[10] Helicopter survey December 12, 1975. Complete.
[11] Helicopter survey December 2, 1976. Complete.
[12] Helicopter survey December 27, 1977. Complete.

1977-78 flight were approximately the same as observed during the 1975-76 flight. Preliminary indications are that many white-tailed deer wintered in areas other than the river bottom during 1976-77.

Age classifications during the December 1977 helicopter survey may have underestimated the percentage of fawns in the population. Twelve fawns were either trapped and marked or were known mortalities on bottoms 4 and 7. A few more fawns, which wintered on these bottoms, were not captured. None of the approximately 40 to 45 deer wintering on bottoms 1 and 2 were captured. A minimum of 6 fawns occurred on these bottoms. Thus, 20 to 25 fawns probably wintered on the river rather than the 14 counted during the helicopter survey.

Known winter mortality included 1 trap mortality, 1 coyote-killed deer and 4 road kills. Three of the four road kills occurred after flooding forced the deer off the river bottoms. Although at least 3 elk were known to have died as a direct result of flooding it is not known if any white-tailed deer died of drowning or exposure.

Distribution

Table 2 shows winter and winter-spring distribution of white-tailed deer by bottom or island during years when complete surveys were made. Preliminary movements information indicates that separating the deer population into three units as previously done (Mackie and Knowles 1976 and Hamlin 1977) is not justified. Six deer trapped in the middle unit during winter have summered in other units. Three have summered in the lower unit and three have summered in the upper unit. Deer observations are separated into units for distributional purposes rather than as population units.

Severe flooding of all bottoms occurred in March 1978. Deer were forced to use adjacent uplands and breaks. White-tailed deer have subsequently been observed in widely scattered locations in the breaks on both sides of the river. Many neckbanded deer have not been accounted for. Further observations will be necessary to determine the extent of displacement caused by the flooding.

LITERATURE CITED

Allen, E. O. 1968. Range use, foods, conditions and productivity of white-tailed deer in Montana. J. Wildl. Manage. 32(1):130-141.

Clover, M. R. 1954. A portable trap and catch-net. California Fish and Game. 40(4):367-373.

Hamlin, K. L. 1977. Population ecology and habitat relationships of white-tailed deer on bottomlands of the Missouri River in northcentral Montana. Pp. 105-113. *In:* Montana Deer Studies. Job Progress Rept. Montana Dept. of Fish and Game, Fed. Aid Proj. W-120-R-8.

Knowles, C. J. 1975. Range relationships of mule deer, elk and cattle in a rest-rotation grazing system during summer and fall. M. S. Thesis. Montana State Univ., Bozeman, MT. 111 pp.

Table 2. White-tailed deer distribution during winter and spring, 1964-77, listed by percent of total per Bottom, Island or Unit.

Date	No. of Obs.	Bottom Number (See Fig. 1)																					
		1	Two Calf Isl.	2	3	4	5	6	7	Harriet Isl.	8	9	10	Isl.	11	12	13	14	15	16	17	18	19	20
Winter-Spring 1964-65	717	3	Tr	1	–	4	–	3	1	2	3	26	1	Tr	2	–	Tr	Tr	7	26	11	2	4	3
Winter 1971-72	267	3	–	4	–	Tr	9	9	8	3	–	17	6	5	–	–	15	–	20	Tr	–	–	–	–
Winter 1973-74	207	4	–	4	–	4	4	4	46	2	–	–	–	–	10	–	19	–	3	–	–	–	–	–
Winter 1975-76	121	18	–	7	–	–	44	12	–	–	–	12	–	–	7	–	–	–	–	–	–	–	–	–
Winter-Spring 1976-77	131	16	–	24	–	–	2	18	4	11	–	25	1	–	–	–	–	–	–	–	–	–	–	–
Winter 1978	406	25	1	15	–	15	–	13	17	4	–	5	–	–	4	–	1	–	–	–	–	–	–	–

Date	No. of Obs.	Upper Unit	Middle Unit	Lower Unit
Winter-Spring 1964-65	717	8	36	56
Winter 1971-72	267	7	51	35
Winter 1973-74	207	13	56	32
Winter 1975-76	121	25	68	7
Winter-Spring 1976-77	131	40	61	0
Winter 1978	406	41	54	5

Mackie, R. J. 1970. Range ecology and relations of mule deer, elk and cattle in the Missouri River Breaks, Montana. Wildl. Monogr. No. 20, 79 pp.

_____, J. G. Mundinger, K. L. Hamlin, and W. D. Schwarzkoph. 1975. Use and effectiveness of four different trapping methods for mule deer on winter range in the Bridger Mountains, Montana. Job Prog. Rept., Mont. Dept. Fish and Game, Fed.Aid Proj. W-120-R, 9 pp.

_____, and C. J. Knowles. 1976. Population ecology and habitat relationships of white-tailed deer on river bottom habitats of eastern Montana. pp. 109-116. *In:* Montana Deer Studies. Job Compl. Rept.,Mont. Dept. Fish and Game, Fed. Aid Proj. W-120-R-7. 170 pp.

Submitted by: Kenneth L. Hamlin

JOB TITLE: Population ecology and habitat relationships of mule deer and white-tailed deer in the prairie-agricultural habitats of eastern Montana.

ABSTRACT:

Population dynamics, distribution and habitat use of mule deer and white-tailed deer are discussed and compared with previous findings. Population estimates indicated an approximate 55 percent increase in wintering mule deer numbers. For the past two years, adult mortality has been extremely low. In contrast to the previous two winters of little or no mortality, moderate over-winter fawn mortality was noted in 1977-78. No population estimates were made for white-tailed deer. Data obtained suggested that losses of white-tailed deer to disease in the summer of 1976, if they occurred, may not have been as severe as previously indicated. Mule deer were found to be closely associated with the rough breaks habitat-cover type. White-tailed deer were found to be associated with agricultural fields and the adjacent bushy coulees.

JOB TITLE: Population ecology and habitat relationships of mule deer and white-tailed deer in the prairie-agricultural habitats of eastern Montana.

JOB OBJECTIVE: To determine the environmental requirements of mule deer and white-tailed deer and factors regulating deer populations in the prairie-agricultural habitats in eastern Montana.

To determine the effects of various potentially competing land use and management practices upon deer in eastern Montana.

To develop new and improved guidelines for management of deer populations and their habitats in eastern Montana.

INTRODUCTION:

The Terry deer study was initiated in September 1975 as a part of the statewide deer research project. The general objective was to determine factors affecting and limiting mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginiana*)numbers in the prairie-agricultural types of eastern Montana. Field studies were conducted from September 1975 through May 1976, after which, fieldwork was continued on a part-time basis. During 1977-78 studies were limited to aerial surveys to make population estimates and follow population dynamics. Coincident with aerial surveys, information was obtained on deer distribution and habitat use. Information collected during 1975-76 and 1976-77 are reported in Hamlin (1976) and Hamlin (1977), respectively.

STUDY AREA

The study area is located in north Prairie and southwestern McCone counties on the west side of Highway 253, starting approximately 10 miles northwest of Terry and extending north to approximately 4 miles south of Brockway. The study area extends as far west as Little Sheep Mountain on the southern boundary and 5 miles west of Brockway on the northern boundary (Fig. 1). Approximately 230 square miles are included within the study area boundaries.

A general description of the topography, vegetation, land uses and history of the area was included in Hamlin (1976).

METHODS

Fixed-wing (Piper Supercub) aerial surveys were made to obtain population estimates, sex and age classifications, distribution and habitat use during three periods: pre-hunting season (October); post-hunting season (January) and spring (March).

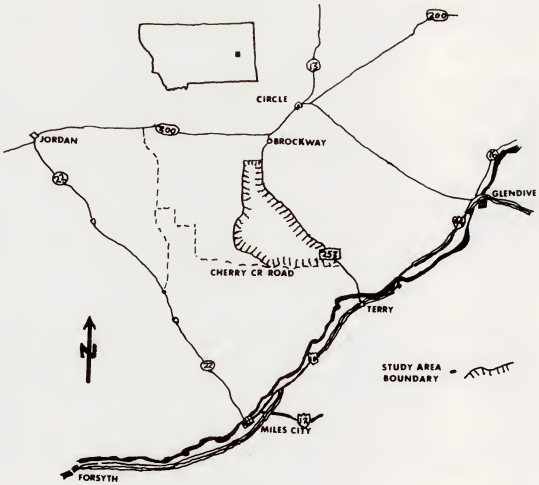


Figure 1. General location of the study area.

POPULATION TREND

Table 1 lists classifications during 1977-78 within the study area. Classifications for 1975-76 and 1976-77 are recorded in Tables 2 and 3, respectively. Complete, deep snow cover made observational conditions excellent during the January flights.

The mule deer fawn/female ratios were higher during fall and winter 1977-78 than during either of the two previous years (Tables 1, 2, and 3). However, due to the severe winter, by March, the fawn/adult ratio had dropped to the same level as 1976 and 1977. Although the over-winter mortality was apparently not severe, it contrasted with the previous two winters when almost no over-winter mortality occurred. Fawn/female and fawn/adult ratios for white-tailed deer also indicate that while over-winter fawn mortality occurred, it was not severe.

Population estimates for mule deer and the computations involved in these estimates are shown in Table 4. These estimates indicated an approximate 55% increase over 1976-77 in wintering mule deer numbers. Although the total number of mule deer calculated to be present is not much different from the number observed, discrepancies occurred in the numbers in comparable sex and age classes. More females and fawns and fewer adult males were observed than were estimated to be present. Fewer adult males observed than expected can at least partially be explained when hunting mortality is included. The calculated winter population estimates do not include hunting mortality. Since no data are available on spring sex ratios of fawns, when population estimates are calculated, fawns surviving through spring are added to the population as 50% males and 50% females. However, if more females than male fawns survived, the calculated estimate would under estimate females and over estimate males. Due to the method of calculation, an under estimate of females would also under estimate the number of fawns. Probably only a small part of the discrepancy in observed versus expected sex and age ratios is explained by surviving fawn sex ratios deviating from 50% male:50% female fawns. The sex ratio of the 79 surviving fawns was probably not the 66 females and 13 males necessary to make the estimates comparable. Also, 13 male fawns added to the population is not consistent with the 32 yearling males observed (Table 1). Random movement of unknown magnitude at the perimeter (82 miles) of the study area is probably more important in explaining observed variations from precise calculations. The calculations and observations are sufficient to estimate approximately 400 wintering mule deer on the Terry Study Area during January 1978.

Classifications and population estimates indicate that adult mortality has been extremely low during the past 2 years. The population has increased both years by approximately the number of fawns surviving through winter. This phenomenon of extremely low adult mortality in an increasing population may prove helpful in comparisons with other areas of stable to declining populations.

Counts and classifications of white-tailed deer on the study area have been quite variable and inconsistent between seasons and years. Preliminary information on movements of white-tailed deer on the study area (Hamlin 1976)

TABLE 1. DEER CLASSIFICATIONS ON THE TERRY STUDY AREA DURING FALL 1977 AND DURING WINTER AND SPRING 1978.

Species		Animals	Total Males	Yrls. Males	Females	Adults	Fawns	Uncl.	Fawns/ 100 Adults	Fawns/ 100 Females
October										
South area	WTD	69	17	8	30	47	19	3	40	63
	MD	195	43	15	85	128	66	1	52	78
North area	WTD	19	3	1	7	10	9	-	90	129
	MD	77	8	5	34	42	35	-	83	103
Entire area	WTD	88	20	9	37	57	28	3	49	76
	MD	272	51	20	119	170	101	1	59	85
January										
South area	WTD	56	1	1	32	33	23	-	70	72
	MD	334	49	25	165	214	119	1	56	72
North area	WTD	243	16	7	123	139	104	-	75	85
	MD	79	8	7	38	46	33	-	72	87
Entire area	WTD	299	17	8	155	172	127	-	74	82
	MD	413	57	32	203	260	152	1	58	75
March										
South area	WTD	17	-	-	-	12	5	-	42	-
	MD	271	-	-	-	184	78	9	42	-
North area	WTD	102	-	-	-	35	23	44	66	-
	MD	48	-	-	-	30	18	-	60	-
Entire area	WTD	119	-	-	-	47	28	44	60	-
	MD	319	-	-	-	214	96	9	45	-

TABLE 2. DEER CLASSIFICATIONS ON THE TERRY STUDY AREA DURING FALL AND WINTER 1975 AND SPRING 1976.

	Species	Total Animals	Total Males	Ylg. Males	Females	Adults	Fawns	Uncl.	Fawns/ 100 Adults	Fawns/ 100 Females
Pre-season ground & aerial										
South area	WTD	76	13	-	28	41	32	3	78	114
	MD	125	25	-	54	79	31	15	39	57
North area	WTD	43	8	-	14	22	18	3	80	129
	MD	49	3	-	31	33	16	-	49	52
Entire area	WTD	119	21	-	42	63	50	6	78	119
	MD	174	28	-	85	113	47	15	42	55
December aerial										
South area	WTD	83	10	7	34	44	26	12	59	76
	MD	117	9	7	71	80	37	-	46	52
North area	WTD	146	19	9	68	86	53	7	62	78
	MD	35	3	2	22	25	11	-	44	50
Entire area	WTD	229	29	16	102	130	79	19	61	78
	MD	153	12	9	93	105	48	-	46	52
April aerial										
South area	WTD	87	-	-	-	46	36	5	78	-
	MD	108	-	-	-	74	34	-	46	-
North area	WTD	146	-	-	-	84	62	-	73	-
	MD	26	-	-	-	12	9	5	75	-
Entire area	WTD	233	-	-	-	130	98	5	75	-
	MD	134	-	-	-	86	43	5	50	-

TABLE 3. DEER CLASSIFICATIONS ON THE TERRY STUDY AREA DURING FALL 1976 AND WINTER AND SPRING 1977.

	Species	Total Animals	Total Males	Ylg. Males	Females	Adults	Fawns	Uncl.	Fawns/ 100 Adults	Fawns/ 100 Females
September aerial										
	WTD	25	3	2	13	16	7	2	44	54
South area	MD	101	17	9	45	62	32	7	52	71
	WTD	49	17	5	19	36	11	2	31	58
North area	MD	24	7	5	10	17	7	-	41	70
	WTD	74	20	7	32	42	18	4	43	56
Entire area	MD	125	24	14	55	79	39	7	49	71
January aerial										
	WTD	77	8	4	28	36	18	23	50	64
South area	MD	210	34	17	103	137	57	16	42	55
	WTD	83	-	-	-	27	25	31	93	-
North area	MD	42	6	3	21	27	15	-	56	71
	WTD	160	-	-	-	63	43	54	68	-
Entire area	MD	252	40	20	124	164	72	16	44	58
March aerial										
	WTD	44	-	-	-	25	19	-	76	-
South area	MD	154	-	-	-	103	51	-	50	-
	WTD	42	-	-	-	28	14	-	50	-
North area	MD	13	-	-	-	7	6	-	86	-
	WTD	86	-	-	-	53	33	-	62	-
Entire area	MD	167	-	-	-	110	57	-	52	-

TABLE 4. POPULATION ESTIMATES FOR MULE DEER ON THE TERRY STUDY AREA.

	TOTAL	ADULTS	FAWNS		ADULT FEMALES	ADULT MALES	
Observed Winter 75-76	153	105	48		93	12	
+ 15% missed	180	124	56		109	15	
Calculated June 1976	180	180	--	+	28	28	
					137	43	
				x	.58	--	58 Fawns/100 Adult Females observed, winter 1976-77.
					79 ff		
Calculated Winter 76-77	259	180	79		137	43	
Observed Winter 76-77	252	175	77		132	43	
Calculated June 1977	260	260	--		178	82	
				x	.75	--	75 Fawns/100 Adult Females observed, winter 1977-78.
					134 ff		
Calculated Winter 77-78	394	260	134		178	82	
Observed Winter 1977-78	413	261	152		204	57	

indicates that movements can be extensive. Also, some important white-tailed deer concentration areas occur near study area boundaries (Fig. 2). Population estimates of white-tailed deer on this study area are unwise until further information on movements and areas of use are obtained.

A comparison of maximum winter counts indicated a 30% decrease in white-tailed deer number in 1976-77 (160) from 1975-76 (233). Although counts of white-tailed deer are difficult to obtain in this area, at least some of this decrease was believed to have been real and related to an outbreak of disease among whitetails in the eastern portion of the state that year (Hamlin 1977, Walcheck 1978). However, when an unknown amount of hunting mortality is added to the maximum number of white-tailed deer observed during January 1978 (299), indications are that mortality due to disease, if it occurred, may not have been as severe on this area as previously assumed.

HUNTER HARVEST

The bag limit in effect for the study area was one white-tailed deer of either sex. In addition, 200 buck only permits were issued for mule deer in HD 731, of which the study area is a portion. The statewide questionnaire estimated that 73 mule deer and 400 whitetails were taken by hunters in HD 731. At least some portion of the 73 mule deer males were probably taken from the study area. Classifications suggest that not more than 15-25 mule deer males were taken on the study area. The number of white-tailed deer estimated taken during 1977 in HD 731 was approximately 20% lower than the harvest during 1976. An unknown portion of these were taken from the study area.

DEER DISTRIBUTION AND HABITAT USE

Figures 2 and 3 show white-tailed deer and mule deer distribution on the study area in relation to important habitat-cover types. Tables 5 and 6 list habitat-cover type use for mule deer and white-tailed deer during fall, winter and spring periods, 1976-1978.

Both Figure 3 and Table 5 indicate the important association of mule deer with the rough breaks type. During spring, the grassland type is indicated as receiving greater use than the rough breaks type. The grassland areas being used, however, are primarily those immediately adjacent to the breaks and on ridges within the breaks. Similarly, the use of green ash, silver sage-snowberry-rose and deciduous shrub types during fall is generally confined to areas adjacent to or within rough breaks.

Figure 2 indicates that most white-tailed deer occur in close proximity to agricultural fields. White-tailed deer are much more common in the northern, more agricultural portion of the area than on the southern breaks-grassland portion. Whitetails again become less common in the extreme northern portion of the area where there is a high degree of agricultural development but little brushy cover. Table 6 indicates that white-tailed deer are most commonly seen in agricultural fields during winter and spring when they are eating the green shoots of winter wheat.

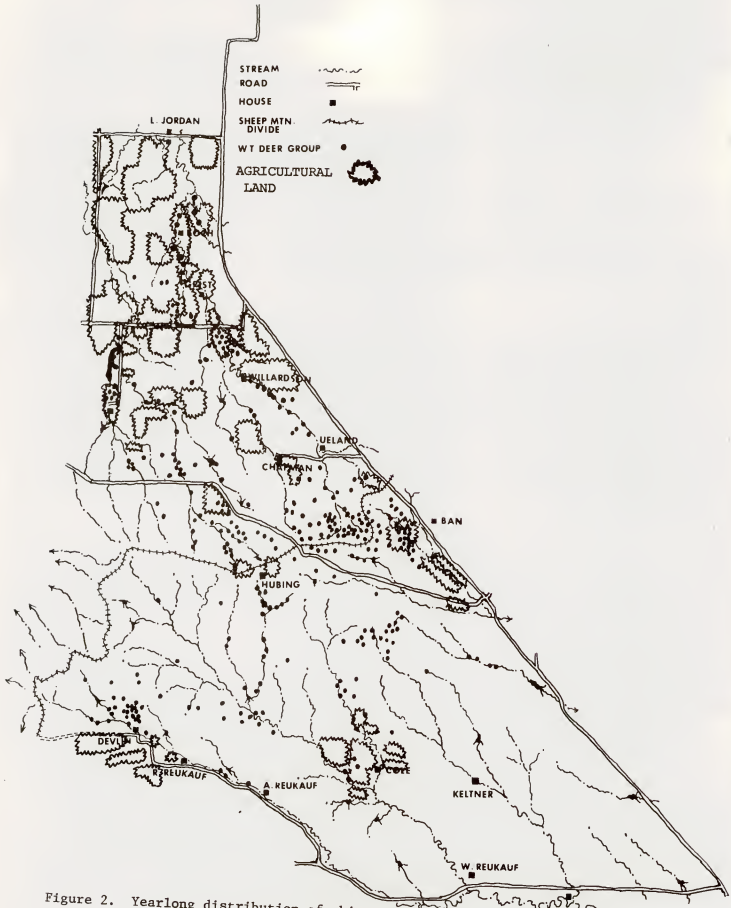


Figure 2. Yearlong distribution of white-tailed deer on the Terry Study Area in relation to agricultural land.

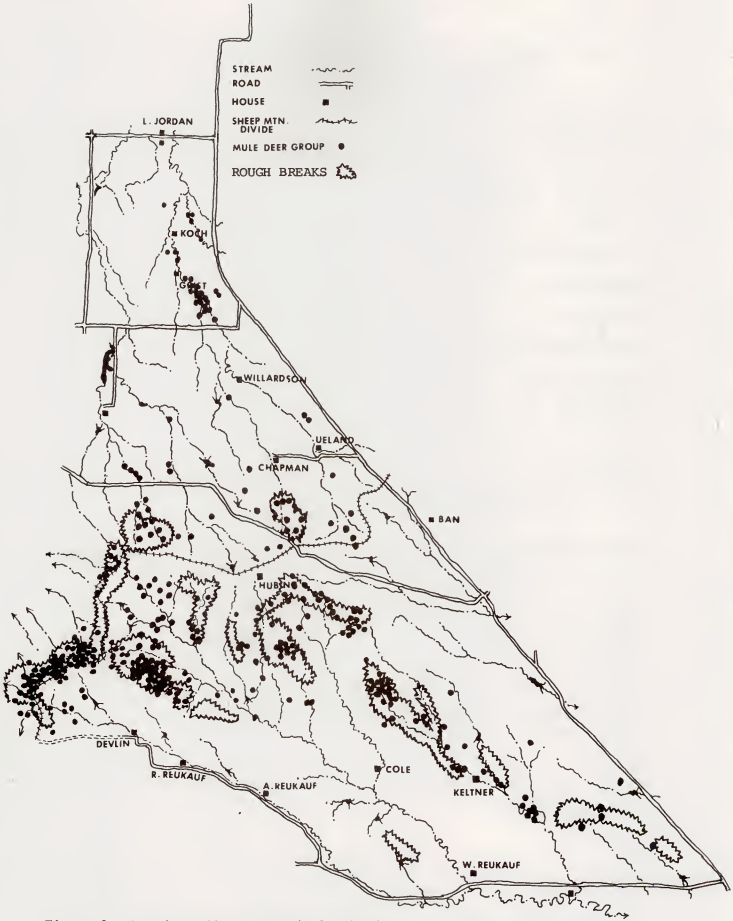


Figure 3. Yearlong distribution of mule deer on the Terry Study Area in relation to the rough breaks habitat-cover type.

TABLE 5. HABITAT USE BY MULE DEER ON THE TERRY STUDY AREA RECORDED AS A PERCENTAGE OF ALL MULE DEER OBSERVED.

Habitat type-Cover type	Sept.-Oct.	Dec.-Jan.	Mar.-April
Silver Sage - Grassland	-	-	1
Grassland	3	tr.[1]	37
Horizontal Juniper - Grass	-	16	8
Rough Breaks	9	71	28
Green Ash	29	5	1
Sage-Snowberry-Rose	30	-	13
Deciduous Shrub	29	8	12
Agriculture	-	-	-
Total Deer	363	592	610

[1] tr. = less than 0.5% of observations.

TABLE 6. HABITAT USE BY WHITE-TAILED DEER ON THE TERRY STUDY AREA RECORDED AS A PERCENTAGE OF ALL WHITE-TAILED DEER OBSERVED

Habitat Type-Cover Type	Sept.-Oct.	Dec.-Jan.	Mar.-April
Silver Sage-Grassland	7	-	-
Grassland	-	12	12
Horizontal Juniper - Grass	-	24	6
Rough Breaks	3	12	-
Green Ash	31	12	16
Sage-Snowberry-Rose	10	tr.	1
Deciduous Shrub	49	8	35
Agriculture	-	31	29
Tctal Deer	109	311	353

LITERATURE CITED

Hamlin, K. L. 1976. Population ecology and habitat relationships of mule deer and white-tailed deer in prairie agricultural habitats of eastern Montana. *In:* Montana Deer Studies. Job Progress Report, Project W-120-R-7. Pp. 139-156.

_____. 1977. Population ecology and habitat relationships of mule deer and white-tailed deer in prairie-agricultural habitats of eastern Montana. *In:* Montana Deer Studies. Job Progress Report, Project W-120-R-8. pp. 135-147.

Walcheck, K. 1978. Epizootics: Mystery deer diseases. Montana Outdoors. 9(4):30-35.

Submitted by: Kenneth L. Hamlin

Job Title: Statewide Deer Carcass Collection

ABSTRACT:

A total of 197 white-tailed and 93 mule deer were examined between 1 July 1977 and 30 June 1978, the third year of the statewide deer carcass collection. The majority of carcasses were collected in winter. Seventy percent of the white-tailed deer and 17 percent of the mule deer were collected west of the Continental Divide. Roadkills accounted for 79 and 49 percent of the mortality for white-tailed and mule deer, respectively. Of the white-tailed deer carcasses examined 35,50 and 15 percent were fawns, adult females and adult males, respectively. For mule deer, these figures were 28, 60 and 12 percent, respectively. Percent pregnancy, litter size and fetuses:100 females examined all appeared to increase from fawns to yearlings and from yearlings to females 2.5 and older for both white-tailed and mule deer. In utero production was 1.68 and 1.55 fetuses per pregnant female for white-tailed and mule deer, respectively. Considerable mortality occurred in both species between birth and the yearling age with greater loss noted for males as compared to females.

Job Title: Statewide Deer Carcass Collection

Objectives: To determine the number and distribution of deer killed along roads and highways in Montana; and to determine and compare basic or potential reproductive rates for both species in major habitat types across the state.

INTRODUCTION

An intensive statewide effort began in winter of 1976 to collect reproductive, condition and food habits information on white-tailed and mule deer. Records of certain biological material were obtained for all deer found dead throughout the year from causes other than hunting. Mackie (1976) when reporting results of the first statewide carcass collection, noted that the primary importance of this type of information in deer management was to compare potential reproduction to realized reproduction on a region-wide habitat basis. Variations in reproductive potential between region and over time can only be documented through consistent, systematic, and intensive collections over a span of several years. During the first year of collections, data were obtained from 132 white-tailed deer and 75 mule deer carcasses (Mackie 1976). Knowles (1977) reported on data obtained from 197 white-tailed and 75 mule deer during 1976-77. This report, for the third year of the statewide deer carcass collection, summarizes cause of death, age and sex distribution and analysis of reproductive tracts for 197 white-tailed and 93 mule deer found dead between 1 July 1977 and 30 June 1978.

PROCEDURES

Procedures, with the exception of food habits, followed those described by Mackie (1976). The food habits aspect of the study was discontinued during 1976-77 as reported by Knowles (1977).

RESULTS

White-tailed Deer

During 1977-78, the third year of the statewide carcass collection, data were collected from the carcasses of 197 white-tailed deer. This was the same number collected during the previous year. Eighty percent of the collection was made during January, February and March of 1978 (Table 1).

Causes of death for all white-tailed deer collected in 1977-78 are listed in Table 2. Roadkills accounted for 79 percent of the mortality (Table 3). This was similar to the percentage obtained during each of the two previous years.

Table 4 shows the distribution of numbers of deer collected by age and sex for each Administrative Region. Seventy percent of the deer were collected in Regions 1 and 2 located west of the Continental Divide. This was similar to the results of collections made in 1975-76 and 1976-77. Of the 124 assigned age females 24, 13 and 63 percent were fawns, yearlings and adults, respectively (Table 5). These figures for the 64 assigned age males were 59, 13 and 28 percent, respectively.

Table 1. Number and percentage distribution by month for collection of 197 white-tailed deer carcasses during 1977-1978.

Month	Number	Percentage
January	38	19.0
February	47	24.0
March	72	37.0
April	17	9.0
May	4	2.0
June	1	0.5
July	2	1.0
August	2	1.0
September	1	0.5
October	1	0.5
November	2	1.0
December	10	5.0

Table 2. Numbers, cause of death and distribution of kill by Administrative Region and statewide for 197 white-tailed deer carcasses found July 1, 1977 to June 30, 1978.

	Cause of Death					
Region	Road Kill	Preda-tion	Illegal Kill	Trap Casualty or Collected	Other	Total
1	92	4	-	7	5	108
2	27	3	-	-	1	31
3	5	-	-	-	-	5
4	16	-	-	-	-	16
5	12	-	-	-	3	15
6	1	-	-	-	1	2
7	2	-	-	16	2	20
Statewide	155	7	-	23	12	197

Table 3. Percentage distribution of cause of death by year for 526 white-tailed deer carcasses found from December 1975 through June 30, 1978.

Year	No. of Deer in Sample	Cause of Death					
		Road Kill	Preda-tion	Illegal Kill	Trap Casualty or Collected	Other	Uncl.
1975-76	132	77	8	2	5	8	0
1976-77	197	75	1	3	11	3	7
1977-78	197	79	3	0	12	6	0
Combined Years	526	77	4	2	10	5	2

Carcass distribution by age (Tables 4 and 5) for white-tailed deer collected in 1977-78 indicated that only 2 percent of all males and 13 percent of the females collected statewide were older than 5 years. A similar trend was noted for data of previous years. If data from carcass collections are representative of actual population age structure, very few male and only a small proportion of female white-tailed deer live past five years of age.

On a statewide basis, percentages of young, adult females and adult males were quite similar between years for the three year collection period (Table 6). When the figures were compared for collections east and west of the Continental Divide, the former had a higher degree of variability between years. Knowles (1977) attributed the differences recorded between years to the large and diverse nature of the area sampled rather than actual changes in population characteristics. Percentages of young, adult females and adult males recorded west of the Divide were very similar for 1975-76 and 1976-77. During 1977-78 the percentage of fawns increased and the percentage of adult males declined.

Reproductive data for all females examined during 1977-78 are listed in Table 7. Eighty white-tailed deer reproductive tracts were examined during this report year which represented a 23 percent increase over 1976-77. Percent pregnancy and ovulation rates were somewhat similar for collections made east and west of the Divide for those age classes where sample size was adequate. In utero productivity appeared to be slightly higher east of the Divide. A comparison of statewide productivity data for 1977-78 with similar data for 1976-77, indicated that ovulation rates and in utero productivity were slightly higher during the latter year while percent pregnancy was nearly the same.

Table 4. Number distribution of 197 white-tailed deer carcasses by age, sex and Administrative Region.

Age	FEMALES Region 1	2	3	4	5	6	7	State-wide Total	MALES Region 1	2	3	4	5	6	7	State-wide Total	Combined Statewide
.5	20	4		1	4		1	30	24	8	2	1	1	2		38	68
1.5	8	3		3			2	16	3	1	1	3				8	24
2.5	9	2	1	3	5		4	24	1			1	1		3	6	30
3.5	10	3					4	17	2							2	19
4.5	9	1		1			1	12	1	2		1			1	5	17
5.5	3	2			1		2	8	2	1		1				4	12
6.5	2	1						3									3
7.5	3	1			1			5		1						1	6
8-10	4						2	6									6
11+	3							3									3
Uncl. Ad.	3	1						4			1	1	1			3	7
Uncl. Age									1							1	1
TOTAL	74	18	1	8	11		16	128	34	13	4	8	3	2	4	68	196

Uncl. Age & Sex
1

Table 5. Percentage distribution of age by sex and area for 188 assigned age white-tailed deer carcasses.

Age	West of Divide			East of Divide			East & West Combined		
	FF	MM	Comb.	FF	MM	Comb.	FF	MM	Comb.
.5	27	70	42	17	33	22	24	59	36
1.5	13	9	11	14	22	17	13	13	13
2.5	13	2	9	36	28	33	19	9	16
3.5	15	4	11	11	11	7	14	3	10
4.5	11	7	10	6	6	7	10	8	9
5.5	6	7	6	9	0	7	7	6	6
6.5	3	2	2	3	0	2	2	0	2
7.5	5	0	4	6	0	4	4	2	3
8-10	5	0	3	0	0	0	5	0	3
11+	3	0	2	0	0	0	2	0	2

When carcass collections made east and west of the Divide were compared over the three year period, pregnancy rates and in utero productivity were similar for most age classes with the exception of 2.5+ females (Table 8). In utero productivity for this age class appeared to be slightly higher east of the Divide. For combined data on a statewide basis, percent pregnancy was 10 percent for fawns, 87 percent for yearlings and 97 percent for females 2.5 years and older. The percentage of single litters decreased from 100 percent for fawns to 23 percent for females 2.5 and older. Fetuses per 100 females examined were 10, 120 and 176 for fawns, yearlings and females 2.5 years of age and older, respectively.

Using evidence from carcass collections, Knowles (1977) showed that fawns suffered considerable mortality between parturition and their first winter. Data collected in 1977-78 further supported this observation. Combined data for all three years showed in utero production to be 165 fetuses:100 adult reproductive tracts examined (Table 8). The fawn:doe ratio obtained from the carcass collection for all three years averaged 66.0 (Table 6). When numbers of fetuses, fawns and yearlings were compared to females 2.5 years and older the ratio dropped substantially with each increase in age class. Ratios for combined data 1975 - 1978 were 176, 89 and 36 fetuses, fawns and yearlings to 100 females 2.5 and older, respectively (Table 9).

Table 6. White-tailed deer carcass numbers, classification, ratios and percentages by area and statewide for 1975-76, 1976-77, 1977-78 and combined.

Year / Area	Numbers					Ratios			Percentages		
	Tot.	Ad.	Yg.	FF	MM	Yg:100 Ad.	Yg:100 FF	MM:100 FF	% Yg	% FF	% MM
1975-76											
West of Divide	84	59	25	40	19	42.3	62.5	47.5	30	47	23
East of Divide	34	21	13	15	6	61.9	86.7	40.0	38	44	18
Statewide	118	80	38	55	25	47.5	69.1	45.4	32	49	21
1976-77											
West of Divide	130	91	39	62	29	42.8	62.9	46.8	30	48	22
East of Divide	55	40	15	29	11	37.5	51.7	37.9	27	53	20
Statewide	185	131	54	91	40	41.2	59.3	43.9	29	49	22
1977-78											
West of Divide	138	82	56	68	14	68.3	82.4	20.6	41	49	10
East of Divide	57	45	12	30	15	26.7	40.0	50.0	21	53	26
Statewide	195	127	68	98	29	53.5	69.4	29.6	35	50	15
Combined Years											
West of Divide	352	232	120	170	62	51.7	70.6	36.5	34	48	18
East of Divide	146	106	40	74	32	37.7	54.1	43.2	27	57	22
Statewide	498	338	160	244	94	47.3	65.6	38.5	32	49	19

Table 7. Summary of white-tailed deer reproductive data for 1977-78.

Area Age Class	Total Deer Exam.,[1]	No. Preg.	Litter Size			Sex of Fetus			Percentages						Ratios		
										Litter Size			Sex				
			Sgl.	Twins	Trip.	FF	MM	Uncl.	% Preg.	% Sgl.	% Twins	% Trip.	% FF	% MM	Fetuses/ Preg. FF	Corpora Lutea/ Preg. FF	Fetuses: 100 FF Examined
West of Divide																	
.5	16	0	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-
1.5	8	7	5	2	0	6	3	0	88	71	29	0	67	33	1.29	1.80	113
2.5+	30	29	8	21	0	16	26	8	97	28	72	0	38	62	1.72	1.96	167
Uncl. Ad.	1	1	1	0	0	0	1	0	100	100	0	0	0	100	1.00	-	100
Total Ad.	39	37	14	23	0	22	30	8	95	38	62	0	42	58	1.62	1.94	154
Total Deer	55	37	14	23	0	22	30	8	67	38	62	0	42	58	1.62	1.93	109
East of Divide																	
.5	2	0	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-
1.5	4	3	1	2	0	4	1	0	75	33	67	0	80	20	1.67	3.00	125
2.5+	19	19	5	13	1	4	20	10	100	26	68	5	17	83	1.79	1.92	179
Uncl. Ad.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Ad.	23	22	6	15	1	8	21	10	96	27	68	5	28	72	1.77	2.00	170
Total Deer	25	22	6	15	1	8	21	10	88	27	68	5	28	72	1.77	2.00	156
Combined Areas																	
.5	18	0	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-
1.5	12	10	6	4	0	10	4	0	83	60	40	0	71	29	1.40	2.00	117
2.5+	49	48	13	34	1	20	46	18	98	27	71	2	30	70	1.75	1.95	171
Uncl. Ad.	1	1	1	0	0	0	1	0	100	100	0	0	0	100	1.00	-	100
Total Ad.	62	59	20	38	1	30	51	18	95	34	64	2	37	63	1.68	1.96	160
Total Deer	80	59	20	38	1	30	51	18	74	34	64	2	37	63	1.68	1.96	124

[1]Five pregnant 2.5+ females and one .5 female collected west and east of the Divide, respectively, were omitted because fetuses were not recovered.

Table 8. Summary of white-tailed deer reproductive data for combined years of 1975-76, 1976-77 and 1977-78.

Area Age Class	NUMBERS: Total Deer Examined[1]	No. Preg.	Litter Size: Sgl.	Twins	Trip.	No. Fetuses	PERCENTAGES: % Preg.	Litter Size: % Sgl.	% Twins	% Trip.	RATIOS: Fetuses/ Preg. FF	Fetuses: 100 FF Examined
West of Divide												
.5	23	1	1	0	0	1	4	100	0	0	1.00	4
1.5	23	20	12	8	0	28	87	60	40	0	1.40	122
2.5+	73	71	17	52	2	127	97	24	73	3	1.74	163
Uncl. Ad.	7	7	3	3	1	12	100	43	43	14	1.71	171
Total Ad.	103	98	32	63	3	167	95	33	64	3	1.70	162
Total Deer	126	99	33	63	3	168	80	33	64	3	1.70	133
East of Divide												
.5	7	2	2	0	0	2	29	100	0	0	1.00	29
1.5	7	6	4	2	0	8	86	67	33	0	1.33	114
2.5+	40	38	8	26	4	72	95	21	68	11	1.90	180
Uncl. Ad.	1	1	0	1	0	2	100	0	100	0	2.00	200
Total Ad.	48	45	12	29	4	82	94	27	64	9	1.82	171
Total Deer	55	47	14	29	4	84	86	30	62	8	1.79	153
Combined Areas												
.5	30	3	3	0	0	3	10	100	0	0	1.00	10
1.5	30	26	16	10	0	36	87	62	38	0	1.39	120
2.5+	113	109	25	78	6	199	97	23	72	5	1.83	176
Uncl. Ad.	8	8	3	4	1	14	100	37	50	13	1.75	175
Total Ad.	151	143	44	92	7	249	95	31	64	5	1.74	165
Total Deer	181	146	47	92	7	252	81	32	63	5	1.73	139

[1]Five pregnant 2.5+ females and one .5 female collected west and east of the Divide, respectively, were omitted because fetuses were not recovered.

Table 9. Comparison of fetal, fawn and yearling ratios to females 2.5 and older for white-tailed deer 1975-76, 1976-77, 1977-78 and combined.

Time Period	Fetuses: 100FF 2.5+	Fawns: 100FF 2.5+	Ylng: 100FF 2.5+	Sample Size			
				No. Fetuses/ No. Repr. Tracts Exam. From FF 2.5+	Fawns	Ylng.	FF 2.5+
1975-76	165.4	88.4	27.9	43/26	38	12	43
1976-77	189.4	98.1	52.7	72/38	54	29	55
1977-78	171.4	82.9	29.3	84/49	68	24	82
Combined	176.1	88.8	36.1	199/113	160	65	180

The in utero sex ratio, statewide, for 1976-78 was 175 males per 100 females. During this time period, sex ratios among fawns and adults in the carcass collection were 114 and 37 males:100 females, respectively. This suggested that males suffered a greater mortality rate than females following parturition.

Mule Deer

During 1977-78, the third year of the statewide carcass collection, data were obtained from 93 mule deer carcasses. A total of 75 carcasses were collected in 1975-76 and the same number in 1976-77. The current collection represented a 22 percent increase over last year. About 67 percent of the 1977-78 carcasses were collected between 1 January, 1978 and 31 March, 1978 (Table 10). Roadkills accounted for 49 percent of the mortality (Tables 11 and 12). This was less than the percentage recorded during both previous collections.

Numbers of deer collected by age and sex for each Administrative Region are shown in Table 13. Eighty-three percent of the mule deer were collected east of the Divide in Regions 3,4,5,6 and 7. This was similar to the results of collections made in 1976-76 and 1976-77. Of the 61 assigned age females 16, 16 and 68 percent were fawns, yearlings and adults, respectively (Table 14). The figures for the 23 assigned age males were 61,22 and 17 percent, respectively. This information, together with combined data for 1975-78 (Table 15) indicated that males have a higher mortality rate than females. Four percent of the males and 20 percent of the females collected statewide were older than 5 years. Young:adult and

Table 10. Number and percentage distribution by month for collection of 93 mule deer carcasses during 1977-78.

Month	Number	Percentage
January	16	17
February	12	13
March	34	37
April	7	8
May	3	3
June	1	1
July	2	2
August	5	5
September	9	10
October	1	1
November	2	2
December	1	1

Table 11. Numbers, cause of death and distribution of kill by Administrative Region and statewide for 93 mule deer carcasses found from July 1, 1977 to June 30, 1978.

	Cause of Death						
Region	Road Kill	Preda-tion	Illegal Kill	Trap Casualty or Collected	Other	Uncl.	Total
1 & 2	7	2	2	-	1	4	16
3	13	4	3	8	9	1	38
4	16	-	2	-	-	-	18
5, 6, 7	10	-	-	-	11	-	21
Statewide	46	6	7	8	21	5	93

Table 12. Percentage distribution of cause of death by year for 243 mule deer carcasses found from December 1975 through June 30, 1978.

Year	No. of Deer in Sample	Cause of Death					
		Road Kill	Preda-tion	Illegal Kill	Trap Casualty or Collected	Other	Uncl.
1975-76	75	76	13	-	-	11	-
1976-77	75	68	3	11	4	4	10
1977-78	93	49	6	8	9	23	5
Combined Years	243	64	7	6	5	13	5

fawn:doe ratios on a statewide basis were quite variable between years, but were generally high (Table 16). Sample sizes were not sufficient to compare productivity between areas east and west of the Divide. Changes between years in population characteristics may be related more to local areas where deer were collected each year than to actual changes on a statewide basis.

Reproductive data for all females examined during 1977-78 are listed in Table 17. A total of 37 reproductive tracts was examined, representing a 51 percent increase over last year. During 1977-78, those collected in females 2.5 years old and older had a lower pregnancy rate and lower in utero productivity than 1976-77, but ovulation rates were the same for both years. For total adults, the percentage pregnant, ovulation rate, and in utero productivity were lower during 1977-78. Sample sizes were too small to make valid comparisons for fawns and yearlings. For combined statewide data 1976-78, percentage of fawns, yearlings and females 2.5 and older that were pregnant were 0, 88 and 92 percent, respectively. The incidence of single litters decreased from 45 percent for yearlings to 34 percent for females 2.5 and older. Fetuses per 100 females examined were 142 and 150 for yearlings and females 2.5 and older, respectively.

Considerable mortality apparently occurs between birth and the yearling age. When numbers of fetuses, fawns and yearlings were compared to females 2.5 and older the ratio dropped substantially with each increase in age class. Ratios for combined data 1975-1978 were 148, 106 and 47 fetuses, fawns and yearlings, respectively, per 100 mule deer females 2.5 years of age and older (Table 18). A similar trend was noted for white-tailed deer.

Table 13. Number distribution of 93 mule deer carcasses by age, sex and Administrative Region.

	FEMALES Region								MALES Region								Combined
Age	1	2	3	4	5	6	7	Statewide TOTAL	1	2	3	4	5	6	7	Statewide TOTAL	Statewide
.5		2	4	3			1	10		1	9	1	2		1	14	24
1.5	2		4	2	2			10		1		3	1			5	15
2.5	2	2	2	3	3			12				2				2	14
3.5	1	1		1	2			5									5
4.5		1	4		1			6									6
5.5			2					2									2
6.5			1	1	3			5									5
7.5					1			1			1					1	2
8-10		2	5	1	1			9			1					1	10
11+					1			1									1
Uncl. Ad.							1	1			1					1	2
Uncl. Age			1					1									1
TOTAL	5	8	23	11	14		2	63		2	12	6	3		1	24	87
	Uncl. Age & Sex																
		1	3	1	1			6									

Table 14. Percentage distribution of age by sex and area for 84 assigned age mule deer carcasses collected in 1977-78.

Age	West of Divide			East of Divide			East & West Combined		
	FF	MM	Comb.	FF	MM	Comb.	FF	MM	Comb.
.5	15	50	20	17	62	30	16	61	29
1.5	15	50	20	17	19	17	16	22	18
2.5	31	0	27	17	10	15	20	9	17
3.5	15	0	13	6	0	4	8	0	6
4.5	8	0	7	10	0	7	10	0	7
5.5	0	0	0	4	0	3	3	0	2
6.5	0	0	0	10	0	7	8	0	6
7.5	0	0	0	2	5	3	2	4	2
8-10	15	0	13	15	5	12	15	4	12
11+	0	0	0	2	0	1	2	0	1

Table 15. Percentage distribution of age by sex for 212 assigned age mule deer carcasses collected statewide from December, 1975 through June 30, 1978.

Age	FF	MM	Comb.
.5	28	56	37
1.5	16	21	18
2.5	13	4	10
3.5	6	10	8
4.5	8	3	6
5.5	8	1	6
6.5	6	0	4
7.5	2	3	2
8-12	11	1	8
13+	1	0	1
No. of Deer	142	70	212

Table 16. Mule deer carcass numbers, classification, ratios and percentages by area and statewide for 1975-76, 1976-77, 1977-78, and combined.

Year / Area	Numbers					Ratios			Percentages		
	Tot.	Ad.	Yg.	FF	MM	Yg:100 Ad.	Yg:100 FF	MM:100 FF	% Yg.	% FF	% MM
1975-76											
West of Divide	6	3	3	2	1	100.0	150.0	50.0	50	33	17
East of Divide	62	31	31	26	5	100.0	119.2	19.2	50	42	8
Statewide	68	34	34	28	6	100.0	121.4	21.4	50	41	9
1976-77											
West of Divide	15	12	3	6	6	25.0	50.0	100.0	20	40	40
East of Divide	54	31	23	21	10	74.2	109.5	47.6	42	39	19
Statewide	69	43	26	27	16	60.4	96.3	59.2	38	39	23
1977-78											
West of Divide	15	12	3	11	1	25.0	27.3	9.1	20	73	7
East of Divide	71	50	21	41	9	42.0	51.2	22.0	30	58	13
Statewide	86	62	24	52	10	38.7	46.2	19.2	28	60	12
Combined Years											
West of Divide	36	27	9	19	8	33.3	47.4	42.1	25	53	22
East of Divide	187	112	75	88	24	67.0	85.2	27.3	40	47	13
STATEWIDE	223	139	84	107	32	60.4	78.5	29.9	38	48	14

Table 17. Summary of mule deer reproductive data for 1975-76, 1976-77, 1977-78, and combined.

Year / Age Class	Total Deer Exam.	No. Preg.	Litter Size: Sgl.	Litter Size: Twins	Litter Size: Trip.	Total Fetuses	Sex of Fetus: FF	Sex of Fetus: MM	Sex of Fetus: Uncl.	PERCENTAGES: % Preg.	PERCENTAGES Litter Size: % Sgl.	PERCENTAGES Litter Size: % Twins	PERCENTAGES Litter Size: % Trip.	PERCENTAGES Sex: % FF	PERCENTAGES Sex: % MM	RATIOS: Fetuses/ Preg FF	RATIOS: Corpora Lutea/ Preg. FF	RATIOS: Fetuses 100 FF Examined
1975-76																		
1.5	4					4											1.00	100
2.5	14					20											1.45	143
Total Ad.	18					24											1.36	133
1976-77																		
.5	2	0	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	0
1.5	4	3	0	3	0	6	4	2	0	75	0	100	0	67	33	2.00	2.00*	150
2.5+	10	10	2	8	0	18	5	10	3	100	20	80	0	33	67	1.80	1.80	180
Uncl. Ad.	2	2	1	1	0	3	1	2	0	100	50	50	0	33	67	1.50	-	150
Total Ad.	16	15	3	12	0	27	10	14	3	94	20	80	0	42	58	1.80	2.00	169
Total Deer	18	15	3	12	0	27	10	14	3	83	20	80	0	42	58	1.80	2.00	150
1977-78																		
.5	2	0	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	0
1.5	8	8	5	3	0	11	2	8	1	100	63	37	0	20	80	1.38	1.43	138
2.5+	26	22	9	12	1	36	19	11	6	85	41	55	4	63	37	1.64	1.80	138
Uncl. Ad.	1	1	1	0	0	1	1	0	0	100	100	0	0	100	0	1.00	-	100
Total Ad.	35	31	15	15	1	48	22	19	7	89	48	48	3	54	46	1.55	1.70	137
Total Deer	37	31	15	15	1	48	22	19	7	84	48	48	3	54	46	1.55	1.70	130
Combined																		
1.5	16					21											1.36	131
2.5+	50					74											1.71	148
Total Ad.	69					99											1.63	144

*sample size = one female with one ovary

Table 18. Comparison of fetal, fawn and yearling ratios to females 2.5 and older for mule deer 1975-76, 1976-77, 1977-78, and combined.

Time Period	Fetuses: 100 FF 2.5+	Fawns: 100 FF 2.5+	Yling: 100 FF 2.5+	Sample Size: No. Fetuses/ No. Repr. Tracts Exam. from FF 2.5+	Fawns	Yling.	FF 2.5+
1975-76	142.8	154.5	36.4	20/14	34	8	22
1976-77	180.0	152.9	82.4	18/10	26	14	17
1977-78	138.5	60.0	37.5	36/26	24	15	40
Combined	148.0	106.3	46.8	74/50	84	37	79

The in utero sex ratio, statewide, for 1976-78 was 103 males per 100 females. During the two year period, sex ratios among fawns and adults in the carcass collection were 150 and 33 males per 100 females, respectively. This suggested a greater mortality of males than females following parturition.

CONCLUSION - DISCUSSION

As compared to 1976-77, the number of white-tailed deer carcasses collected during 1977-78 were the same, while mule deer carcasses increased 20 percent. The majority of carcasses for both species were collected in winter. Carcass collections for the two species were unevenly distributed. Most of the white-tailed deer were collected west of the Divide, while the majority of mule deer were collected east of the Divide. Road kills accounted for most of the mortality in both species. For combined data, 1975-1978, male fawns comprised twice the percentage of female fawns for both species. Among white-tailed deer, only 13 percent of the males and 26 percent of the females were 4.5 years of age or older (Table 19). For mule deer 4,5 years and older, 8 and 36 percent were males and females, respectively. These data indicate for both species that males have higher turnover rates than females. On a statewide basis, young:adult and fawn:doe ratios were higher for white-tailed deer than for mule deer during 1977-78. During 1975-76 and 1976-77 these ratios were higher for mule deer. Percentages of fawns, adult females and adult males for white-tailed deer and mule deer were quite similar for combined data 1975-1978. For both species, adult females comprised the largest percentage of the carcasses and adult males the smallest percentage. Percentages of females pregnant, in utero production, and ovulation rates varied from year to year

Table 19. Percentage distribution by sex and age class for white-tailed and mule deer collected during 1975-1978.

Age	White-tailed Deer			Mule Deer		
	FF	MM	Comb.	FF	MM	Comb.
.5	25	50	34	28	56	37
1.5	15	19	17	16	21	18
2.5	17	12	15	13	4	10
3.5	17	6	13	6	10	8
4.5+	26	13	21	36	8	27
Sample Size	293	173	466	142	70	212

for each species but were well within the ranges reported for white-tailed deer and mule deer in other areas (Knowles 1977). Considerable mortality occurred between birth and the yearling age for both species. Knowles (1977) suggested that the ratio of yearlings to females 2.5 and older probably expresses recruitment better than a fawn:doe ratio.

RECOMMENDATIONS

For the past 3 years, the intensity of carcass collections have not been great enough to permit a comparison of potential reproduction to realized reproduction on a region wide habitat basis. To accomplish this goal in the future, greater effort must be made by Department of Fish and Game and cooperating agency personnel to examine, collect reproductive tracts and report deer found dead from all non-hunting mortality, especially during the December 15 to June 15 period to improve sample sizes and provide increased reliability of data.

LITERATURE CITED

Knowles, C. J. 1977. Statewide deer carcass collection. In: Montana Deer Studies. Job Compl. Rept., Mont. Fed. Aid Proj. W-120-R-8.

Mackie, R.J. 1976. Statewide deer carcass collection. In: Montana Deer Studies. Job Compl. Rept., Mont. Fed. Aid Proj. W-120-R-7.

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